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**The Rock-hunter's
Field Manual**



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The Rock-hunter's Field Manual

A GUIDE TO IDENTIFICATION
OF ROCKS AND MINERALS

by

D. K. Fritzen

1965

FOREWORD BY
WESLEY DEXTER GORDON

Drawings by Lon Fox

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THE ROCK-HUNTER'S FIELD MANUAL

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I am deeply indebted to Mr. Oliver E. Bowen, Jr.,
senior mining geologist of the California State
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preparation of this manual.

D. K. F.

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Foreword

BY

WESLEY DEXTER GORDON

Association of Geology Teachers

Graves of our remotest ancestors have given up to archeologists and anthropologists many colorful pebbles. Among many American Indian tribes, only the medicine man's magic was powerful enough to control and use quartz and other crystals. Ancient, sacred literature of all lands contains many references to beautiful rocks and minerals: alabaster, sard, carnelian, jasper, amethyst, sapphire, garnet, ruby, and many others.

Today, collecting handsome and unusual rocks and minerals is one of this nation's most rapidly growing pastimes. Beautiful color reproductions in nationally circulated magazines attest to the growing hobby of "Rock Hounding."

Too often, however, amateur rock collectors cheat themselves out of one of the keenest satisfactions—classification according to natural relationships. In this book, D. K. Fritzen presents a lucid, nontechnical guide that should help the reader to more easily name (and thus classify) his finds.

This system for identification is based on color. But as the author makes perfectly clear, color alone as a means of naming specimens can be misleading. Commonly, for example, we think of the red ruby and the blue sapphire, the purple amethyst and the yellow topaz; however, stones with basic compositions identical to these highly colored prizes also come colorless. Thus, amethyst is really a naturally colored form of quartz crystal. The common characteristics of these minerals, except the color, are identical for all practical purposes,

and the author presents these common, physical characteristics for each color commonly found in the mineral.

Often highly colored, eye-catching, correctly labeled collections are organized in beautiful cabinets by amateurs who really have little knowledge of the most fascinating facts about their beauties. The exciting relationships are missing. The author wisely includes here a description of the general appearance of rocks in which minerals are commonly found. The best way to make a cabinet specimen mean something more than its mere name is to know the conditions under which it was formed. A beginning of this understanding is to know something about the rocks containing the display items. This section of the book should be of special assistance to the amateur collector and classifier.

Preface

Rock-hunting and prospecting have become national hobbies within the last few years, and literally thousands of people "take to the hills" every week end in search of mineral deposits, gem stones, or just pretty rocks. The identification of such minerals is not difficult for those who are trained in mineralogy, but to the amateur it presents a major problem, and it is for the amateur that this manual has been designed.

This book presents a simplified method of identification based on color. By first determining the color of a mineral in the Color Key, and making the various tests explained in the Instruction section, it is possible to identify the specimen. Additional information relating to its crystal description, use, occurrence, and the other minerals that are likely to be found in the same area, is given in the Mineral section, which is arranged in alphabetical order. A brief account of the appearance of various rocks in which minerals are found is given in the Rock section.

Many more elaborate methods of mineral identification exist involving the use of acids, blow pipe, etc., but inasmuch as such tests require a great deal of equipment and should be conducted in a laboratory, they have not been included in this field manual.

The term "rock-hunter" applies to one who seeks rocks and minerals to be placed in a collection, while "prospector" refers to one who searches for mineral deposits for the purpose of mining. The prospector, therefore, requires explicit instructions covering the areas that are open to mining operations, the size of the samples necessary for assaying, and the procedure of staking and filing a claim. The majority of

states maintain a Division of Mines from which it is possible to obtain a pamphlet containing such information.

There is a great deal of pleasure and satisfaction in finding and identifying a mineral, and through the proper use of this field manual anyone will be able to determine, quickly and easily, whether or not his find is worth keeping. It is a great hobby—and it can be profitable, too!

D. K. F.

Oakland, California
November 1, 1958

PART I

1 - Introduction

WHAT ARE ROCKS AND MINERALS?

THE quiz game "Animal, Vegetable or Mineral" points out the fact that if a substance is not animal or vegetable it must be mineral. Therefore, a mineral can be defined as being a natural substance, having a definite chemical composition, that has not been formed as a product of animal or vegetable life. Coal, for instance, is decomposed vegetation and cannot be considered a mineral, nor can a pearl, which is the product of animal life. Man-made synthetic gem stones, although beautiful and at times difficult to distinguish from the real ones, are not minerals because they have not been formed naturally.

Rocks are also natural formations, but to the scientist they are much more than large solid objects—they are the material that makes up the bulk of the earth's outer layer, or crust, and can be composed of animal, vegetable, or mineral matter, although the majority of them are made up of minerals. Since this manual is concerned principally with minerals, rocks here are considered as solid substances of no particular shape, composed of one or more minerals, and ranging from fist-size to boulders or cliffs. The smaller, loose fragments are termed pebbles.

Inasmuch as rocks are made up of minerals, how can a person distinguish one from the other? In general, minerals have certain outstanding characteristics, as listed in the Color Key (Chapter 4), by which they can be identified. Rocks are identified by their mode of origin, texture or graining, and the minerals they contain. A condensed account of the formation of rocks, together with a brief description of

their general appearance, is given in the Rock Section (Chapter 2).

Not all minerals, however, are contained in rocks. Gold and platinum, for instance, are also found as free minerals in placer deposits, and grains of quartz, garnet, zircon, magnetite, etc., are found in beach and river sands. It is interesting to study such sand under a magnifying glass and try to identify the individual particles. Most of the grains will be clear and glassy quartz, but some will be red garnet, or slightly



A magnifying glass having three lens that will magnify from five to twenty times

tinted zircon. A magnet drawn through the sand will pick up the black grains of magnetite, and possibly some brownish-black chromite; black grains that do not respond to the magnet will be rutile or ilmenite. These same minerals also occur in crystal form, or as rock-like masses without visible crystal faces.

WHERE ARE THEY FOUND?

Rocks and minerals are probably the most plentiful and unevenly distributed substances known. In some localities as many as seventy-five to one hundred different minerals may be found within the space of a few miles, while in other areas possibly as few as five or ten; but a person's own back

INTRODUCTION

yard or immediate vicinity will generally yield a sufficient variety with which to start a collection.

It takes only a few minutes to pick up and examine a rock or pebble—is it lighter or heavier than others of comparative size? Is the color solid or streaked? Would the inside be the same as the outside? Does it contain something of value? The act of picking up that first rock because its color or shape appeals to the individual is the beginning of a collection.

The collecting of rocks and minerals is a hobby that is not confined to a particular area or state. A mountain, stream or river bed, seashore, desert, or volcanic area in any place in the world is a potential field of activity. Places where ero-



A small, but strong, horseshoe magnet

sion or a landslide has occurred, fresh cuts in banks or hillsides, excavations, quarries, and old mine dumps are particularly productive for collector's items.

The outer appearance of rocks and minerals can be very deceiving; platinum, for example, may look like a dirty-gray stone, or the lovely jadeite may be covered with a gritty light tan coating. Many rocks that look uninteresting on the outside may be beautiful on the inside, so never turn away from a rock, or reject it, until it has been thoroughly investigated by scratching the surface, breaking, or washing. Any rock about which there is a doubt should be taken to a mineral store where the proprietor will saw it in half for a small charge, usually twenty-five cents to one dollar depending upon the size of the rock.

EQUIPMENT

A certain amount of equipment is necessary in the pursuit of buried treasure, and it is fairly inexpensive. Ten dollars will probably cover the cost of a prospector's pick and a cold chisel for digging out and breaking rocks, a pocket knife, steel file, small magnet and streak plate for testing, and a



A prospector's pick

magnifying glass. Other equipment undoubtedly will be added from time to time—a shovel, sieve, possibly a sledge hammer, and a gold pan, since much of the collecting is done in stream beds. The more expensive items, such as a Geiger counter or a portable ultraviolet light, are useful but they



A cold chisel

are necessary only in the search for uranium, thorium, or tungsten minerals.

ARRANGING A COLLECTION

In the gathering of all specimens, whether for a collection or for analysis of economic worth, it is wise to label each find with such notations as location, the type of rock or area in which it is found, and the date. Some collectors number the specimens with adhesive tape, and keep the record in a notebook; others use a small paper or cloth bag for each sample and enclose the information on a slip of paper. Permanent

INTRODUCTION

labels can be applied after the mineral has been cleaned with soap and water, or with alcohol in the case of water-soluble minerals such as halite and borax.

The most popular system of labeling a collection is the number-and-notebook method used on field trips, substituting



A specimen cabinet with partitioned drawers

a small square of white paint or enamel for adhesive tape. When the paint is dry, the specimen should be numbered with India ink, and the square protected by a thin coating of clear fingernail polish. The system of displaying a label next to a specimen is used also, but as a precaution against loss the specimen should be numbered and catalogued.

2 - Formation and Appearance of Rocks in Which Minerals Are Found

THE story of rocks and their formation is a study in itself, and far too complex to present in a field manual; however a condensed description of the more common rocks will prove most helpful in recognizing and understanding them. Almost all rocks are made up of small mineral crystals, crystal fragments, or grains. In some rocks these fragments are clearly visible without the aid of a magnifying lens, while others will look dull and noncrystalline; yet these same dull rocks, when viewed under a lens, will usually show very tiny crystalline particles.

The three rock classifications, igneous, sedimentary, and metamorphic, are explained in the following pages. However, it should be noted here that each classification has certain characteristics by which it is generally possible to distinguish one from the other.

Igneous rocks, with the exception of those composed wholly or partly of glass, are made up of mineral particles which more or less interlock with each other and have an even, uniform appearance in all directions. They are rarely, if ever, in layered or banded formations.

Sedimentary rocks have a layered or banded appearance, and the mineral grains stand out individually rather than interlock with each other.

Metamorphic rocks usually are crystalline, and have a layered effect due to the roughly parallel and interlocking arrangement of the mineral particles.

Igneous rocks, then, can be distinguished from both sedi-

mentary and metamorphic rocks by the absence of layering or banding; and sedimentary and metamorphic rocks differ in the arrangement of their mineral particles.

IGNEOUS ROCKS

Igneous rocks are those which have been formed by the cooling and solidification of a once hot magma, a semi-liquid deep under the surface of the earth, and are divided into the two classes: the intrusive rocks which were slowly cooled and hardened within the earth, giving the minerals contained therein an opportunity to separate and enlarge; and the volcanic, or lava, rocks which were formed as a result of volcanic action disgoring them to the earth's surface where they were rapidly cooled and hardened, allowing the minerals little opportunity to separate and enlarge. Rocks of volcanic glass, obsidian, pitchstone, and pumice, occurred in this way.

Igneous rocks, either intrusive or volcanic, are frequently found showing prominent well-shaped crystals embedded in a base, or groundmass, of a finer grained material. The largest of the crystals thus embedded are called *phenocrysts*, and the rocks, exhibiting such a definite distinction between the size of the crystals and the groundmass, are called *porphyries*. The phenocrysts are generally of a single mineral and, because they may vary in size from one-quarter of an inch to well over one inch in diameter, they are excellent items for the collector.

The igneous intrusive rocks described below—granite, syenite, diorite, gabbro, and peridotite—have one thing in common: the mineral grains, or small crystals, are all approximately the same size, and are coarse enough to be visible without the aid of a magnifying glass. Of the five mentioned rocks, granite is the only one that contains quartz in any appreciable amount.

Granite is the most common and abundant of the group, and is generally light colored, light to dark gray, whitish, reddish, yellowish. The darker minerals, sometimes in very

good crystals, occasionally will be grouped together, and the rock will have a mottled look. Or they will be more or less evenly divided giving a salt-and-pepper appearance.

Syenite is very much like granite in appearance, but lacking in quartz; therefore the luster is less glassy. It is most commonly found in some shade of gray, but could be yellowish, pinkish, or whitish, and generally shows very little mottling.

Diorite has about equal amounts of dark and light minerals, and is usually gray to dark gray to dark green in color.

Gabbro is a tough, heavy rock made up principally of dark minerals which give an overall coloring of dark gray, dark green, or black, possibly with a mottled appearance.

Peridotite has a duller luster and is very dark in color, dull dark green to black, with occasional smooth shiny spots. Due to weathering, the rock may become soft enough to be broken easily with a hammer. Commercial deposits of chromium and nickel ores are frequently found in peridotite, and occasionally small amounts of platinum are present.

Dunite, a variety of peridotite, is made up wholly of the mineral olivine, and is lighter in color than peridotite, being more of a yellowish-green. *Kimberlite* is the variety of peridotite in which diamonds are found. It is a rather soft, yellow rock on the surface, but blue underground.

Pegmatites are exceedingly coarse-grained igneous rocks that are easily recognized by the huge crystals, and in some places contain gem quality tourmaline, topaz, and beryl, as well as lithium, and occasionally uranium minerals. Pegmatites frequently lie in dikes cutting across granite, diorite, syenite, and a wide variety of metamorphic rocks. They are ordinarily uncovered by mining operations or erosion.

The volcanic rocks described in the following paragraphs are rhyolite, trachyte, andesite, and basalt, and come under the general heading of lava. Mostly they are fine-grained, ordinarily having mineral particles so tiny and crowded together they cannot be seen as individuals with the aid of a

magnifying glass, or are slightly honeycombed with holes, sometimes large, caused by the escape of hot gasses and the rapid cooling and hardening of the lava.

Frequently these holes are later filled with other mineral matter, and the resulting rock is a *geode*. These rocks are round or egg shaped, and range from walnut sized pebbles to larger than baseballs. They are usually found embedded in a limestone or sandstone bank or hillside, but could be found almost anywhere. They are normally a light brown, tan, or buff color, with a sandy or gritty exterior that is sometimes ribbed, and they tend to be lighter in weight than an ordinary rock. When broken open they reveal a cavity lined with opal, chalcedony, or well-formed crystals of quartz or amethyst.

Rhyolite is generally light colored, grayish, whitish, yellowish, brownish, or reddish, with the color sometimes deepening to darker shades as the rock is exposed to the weather. It frequently shows ornamental lines or bands caused by the flowing and hardening of the lava. Black or dark red *obsidian* with a brilliant glassy luster is a volcanic glass of rhyolite, as is brown, pitchy-looking *pitchstone*; pumice is a whitish, frothy, honeycombed glass that is very light in weight.

Trachyte commonly shows lava flow lines with the crystals parallel to the direction of flow, and is normally a light gray, red, or yellow.

Andesite is ordinarily darkened in color than either rhyolite or trachyte, and frequently has a very dull luster. It is commonly dark gray to dark green, possibly with a mottled appearance.

Basalt is the most common and abundant of the lava rocks, and is dark gray, dark red, dark green, or near black. It is a heavy, dense rock with twisted rope-like flow lines usually marking the surface. Generally there are numerous small gas pockets that will be filled with various minerals.

SEDIMENTARY ROCKS

Sedimentary rocks are those which have been formed by various acts of nature: by fragments of rock and soil being carried by water or wind to areas where it gathered and hardened with sand and other materials; by the accumulation of the remains of marine organisms, coral, etc., and by the evaporation of mineral-bearing water. Rock salt, gypsum, and anhydrite were produced by the latter method.

Sandstone is composed of layer upon layer of coarse-grained sand more or less firmly cemented together. It could be of one color, white, tan, gray, red, or yellow, or have layers of alternating colors. The sandstone of the Colorado plateau, which has yielded rich uranium deposits, is a tan or buff color with alternating layers of red or brown. Sandstone could be confused with the metamorphic rock, quartzite. However, sandstone has the distinguishing feature of breaking around the grains of sand when fractured, whereas quartzite breaks across the grains. This difference can be seen clearly under a magnifying glass.

Shale is exceedingly fine-grained mud, silt, and clay that has been deposited in thin layers or plates and hardened; although soft and brittle, it can be split along the lines of the layers. The rock-forming mineral particles are usually so tiny they cannot be seen as individuals under a magnifying lens, but crystals of pyrite are occasionally found, particularly in the very dark colored varieties. Shale is commonly some shade of gray, but could be whitish, black, or shades of green, red, or brown. *Clay shale* has the same general characteristics as ordinary shale, but the color may be streaked or spotty due to the abundance of the clay mineral, kaolinite.

Limestone is formed primarily from the remains of marine life, coral, shells, etc., and consists principally of the mineral calcite. They are more or less crystalline rocks, some being so fine-grained a magnifying glass is necessary to see the mineral particles as individuals, while others are coarse enough to be

FORMATION AND APPEARANCE OF ROCKS

clearly visible without a lens. Limestone has a wide variety of colors, yellow, brown, tan, black, white, gray, and occasionally dark red. Deposits of copper, lead and silver ores often occur in limestone. When the mineral dolomite replaces all or part of the mineral calcite, the rock becomes *dolomite*, or *dolomitic limestone*.

METAMORPHIC ROCKS

Metamorphic rocks are those which have been changed physically or chemically by application of heat, or pressure, or both. The rocks thus changed, either igneous or sedimentary in origin, usually become harder and more crystalline.

Contact metamorphism is the change caused by a molten igneous mass within the earth entering an already established rock mass in the earth's crust. The heat, gases, and moisture accompanying the igneous mass escape to the surface, and the rocks around the contact will become harder and more resistant to erosion. Such an area is termed the *contact zone*. Other noticeable changes also occur: blue knots of the mineral cordierite will generally form in slates and give a spotted effect, and an irregular surface area ringed by rough concentric circles usually appears. Contact metamorphism has produced many fine gem and mineral deposits.

The following rocks are the results of general metamorphism:

Gneiss is a crystalline rock in which layers of light colored minerals alternate with layers of darker minerals forming coarse, somewhat parallel bands or streaks. The bands are sometimes so curved or contorted that the rock as a whole will appear wavy. A gneiss could be almost any color—white, gray, red, green, brown or black—and the mineral grains are almost always visible without the aid of a magnifying glass. Gneisses are designated by the rock from which they were formed, such as granite gneiss, syenite gneiss, diorite gneiss, etc., or by the principal mineral contained therein, such as garnet gneiss, etc. The coarse banding of a gneiss is a

feature that usually serves to distinguish it from a schist, which is characterized by thin parallel layers.

Schist is a crystalline coarse-to-fine-grained rock made up of thin layers or sheets which can be split easily along the length of the layers. The color ranges from very light to very dark, and the mineral grains are usually visible without the aid of a lens. Schists are also designated by the principal mineral contained therein.

Serpentine is a soft rock derived from the alteration of peridotite, and is made up principally of the mineral serpentine. The color—dark green, yellowish-green, brownish or reddish—is usually mottled or streaked, and the texture is often fibrous. Serpentine frequently feels smooth and somewhat greasy.

Marble, or *crystalline limestone*, is a soft rock of altered limestone or dolomite having mineral grains that are generally coarse enough to be seen without a lens. It could be of one color—white, gray, green, red, black—or a combination of colors giving a streaked or spotted effect.

Slate is a rock derived from the alteration of shales and clays, and the mineral grains are usually so tiny they can be seen only with a lens. It is made up of thin, more or less parallel layers, and can be split easily along the lines of the layers. Slate is commonly dark gray to black in color, but also could be bluish, greenish, reddish, or brown.

Quartzite is a hard, compact, crystalline rock originating from quartz-grained sandstone, and having mineral grains that are normally coarse enough to be seen with a lens. It is usually some light color—whitish, grayish, reddish, or yellowish—but could range into brown or black. Quartzite can be distinguished from sandstone by the fact that quartzite fractures across the grains of sand, whereas sandstone breaks around them.

PART II

3 - How to Determine the Physical Properties of Minerals

COLOR

Color alone is not sufficient for the identification of minerals, but it is a starting point and must be used in connection with the other tests. Many minerals will tarnish, or their colors will darken on exposure to the weather; therefore, it is necessary that all minerals be fractured, or broken, and the color determined from the freshly fractured surface.

The majority of minerals will be found in two or more colors, and are arranged alphabetically and cross-filed according to color. Calcite, for instance, could be black, blue, brown, colorless, gray, green, red, white, or yellow, and is listed in each of these color sections.

Ten basic colors and their variations are given in this manual: black, blue, brown, colorless, gray, green, purple, red, white, and yellow. If a mineral is yellowish-green, it will be listed as yellowish-green in both the yellow and green sections; a tan mineral will be in the brown section, a pink mineral in the red section, a lavender mineral in the purple section, etc. In the Mineral section, also in alphabetical order, a complete range of colors is given for each mineral.

LUSTER

Luster is the outward appearance of a mineral, and is in three classifications: metallic, submetallic, and nonmetallic. The terms "glassy," "pitchy," "earthy," etc., are used to further describe the degree of luster.

A mineral having a metallic luster has the appearance of a metal (gold, silver, copper, etc.) and is opaque—light cannot be seen through it.

A submetallic luster is between metallic and nonmetallic and a mineral having such a luster can be opaque, or faintly translucent—light can be seen faintly through the thin edges.

Minerals having a nonmetallic luster can be transparent—objects and light can be seen clearly through them; translucent—light but not objects can be seen; or opaque.

STREAK

When a mineral is rubbed across the surface of a piece of unglazed porcelain, called a streak plate, it leaves a fine powder that may be of an entirely different color than the mineral itself. This powder is called the streak, and should always be obtained from a freshly fractured surface. Minerals having a metallic luster normally have a dark colored streak, while those having a nonmetallic luster have colorless or very light colored streaks.

A streak plate can be purchased in any mineral store for about twenty-five cents, and is generally small enough to be carried easily in a pocket.

HARDNESS

Every mineral possesses some degree of hardness, ranging from very soft (1) to very hard (10), and the test for determining the right degree is quite simple. Minerals having a hardness of 1–2 can be scratched by the fingernail, 2½–3 by a copper coin, 3½–5 by a knife blade, 5½–6 by a steel file, 6½–7 by a piece of quartz. Minerals over 7 will scratch quartz; minerals of 6 or over will generally scratch glass. The scratches should be as small as possible, but deep enough to mark the mineral itself, as a surface scratch will rub off and a true reading would not be obtained.

The weight of each mineral is given as light, medium, heavy, or very heavy. A feeling for weights will develop

with experience, and it will then be possible to actually "feel" the difference between a heavy mineral, such as galena or garnet, and a lighter mineral, such as opal or gypsum.

CLEAVAGE

Cleavage is the way in which a mineral breaks smoothly and naturally. Small irregularities, such as surface steps or cracks, or inner lines running through a mineral, generally mark the cleavage planes, and if the tip of a knife blade or a chisel is placed on one of these lines and tapped with a



A piece of Iceland spar, a transparent variety of calcite, showing spaces where cleavages have been made. Each cleavage of this mineral will yield a small fragment similar to Fig. 21 (page 150).

hammer, the mineral will break in definite directions. Cleavage is always parallel to an actual or possible crystal face, and is not confined to just one location in a crystal or crystalline mineral, but rather is repeated throughout the mineral. In a densely packed mineral, a crystal face may be found by its mirror-like reflection as a beam of light is played over it. This reflection, incidentally, will show from only one angle.

FRACTURE

If a mineral does not have natural cleavage lines, and it is tapped with a hammer, it will break, or fracture, with irregular surfaces. A shell-like fracture will have a smooth curved surface similar to the inside of a sea shell. Glass will ordinarily break in this manner. The terms used to denote other fracture surfaces—jagged, uneven, granular, etc.—are self-explanatory.

CRYSTALS

A crystal description of each mineral is given in the Mineral section, although in most cases individual crystals are not plentiful, and are considered collector's items. The minerals themselves normally will be found in other forms: as stalactites; in little rounded lumps resembling bunches of grapes; in rock-like masses without clearly visible crystal faces; in kidney-shaped masses; as coatings on other minerals, etc.

4 - Color Key

BLACK

Pitch-black, brownish-black; may have yellow-brown coating.

LUSTER: nonmetallic; resinous, pitchy; translucent on thin edges.

STREAK: colorless to brownish.

HARDNESS: 5½-6, can be scratched by a steel file. Medium weight.

FRACTURE: roughly shell-like to uneven; brittle.

NOTE: slightly radioactive.

Allanite

Black.

LUSTER: metallic; bright on fresh fracture, dull after exposure to air; opaque.

STREAK: dark gray to black, shiny.

HARDNESS: 2-2½, may possibly mark paper; can be cut easily with a knife and slightly flattened with a hammer. Very heavy.

FRACTURE: roughly shell-like.

Argentite

Black.

LUSTER: nonmetallic; glassy; translucent on thin edges.

STREAK: colorless.

HARDNESS: 5-6, can be scratched by a steel file, possibly by a knife blade. Medium weight.

CLEAVAGE: in two directions, with cleavage lines meeting at an angle of near 90°.

Augite

Black.

LUSTER: nonmetallic; glassy, shining; pearly on cleavage surfaces; transparent in very thin plates, and translucent, possibly opaque, in thicker plates.

BLACK

STREAK: colorless.

HARDNESS: 2½-3, can be scratched by a copper coin, possibly by the fingernail. Medium weight.

CLEAVAGE: perfect parallel to base, separating easily into very thin elastic plates of light gray color.

Biotite

Black.

LUSTER: nonmetallic; glassy to earthy; transparent to translucent.

STREAK: white to gray.

HARDNESS: 3, can be scratched by a copper coin. Medium weight.

CLEAVAGE: perfect in three directions at oblique angles, yielding smooth-surfaced fragments similar to figure 21.

NOTE: will frequently fluoresce in ultraviolet light.

Calcite

Black.

LUSTER: nonmetallic; brilliant sparkle in crystals to dull in masses; translucent to opaque, rarely transparent.

STREAK: white to very pale brown.

HARDNESS: 6-7, can be scratched by quartz, possibly by a steel file. Very heavy.

FRACTURE: rough, uneven.

Cassiterite

Black, bands of black and white or black and reddish-brown.

LUSTER: nonmetallic; waxy, glassy, dull; transparent to translucent.

STREAK: colorless.

HARDNESS: 7, can be scratched by quartz. Medium weight.

FRACTURE: shell-like; brittle.

Chalcedony

Black, gray-black. May have green spots or coating.

LUSTER: metallic to dull; opaque.

STREAK: grayish-black to black.

HARDNESS: 2½-3, can be scratched by a knife blade, possi-

bly by a copper coin; may be cut with a knife. Medium weight.

FRACTURE: granular to shell-like.

Chalcocite

Iron-black, brown-black.

LUSTER: submetallic to metallic; frequently pitchy; translucent to opaque.

STREAK: brown.

HARDNESS: $5\frac{1}{2}$, can be scratched by a steel file, possibly by a knife blade. Medium weight.

FRACTURE: uneven; brittle.

NOTE: may be slightly magnetic.

Chromite

Black.

LUSTER: nonmetallic; glassy to earthy; translucent to opaque.

STREAK: light blue to almost white.

HARDNESS: 2-4, can be scratched by a knife blade, possibly by a copper coin. Light weight.

FRACTURE: shell-like.

NOTE: if touched to the tongue, will often stick to it.

Chrysocolla

Iron-black, brownish-black.

LUSTER: submetallic; resinous; bluish tint on fresh fracture; opaque to faintly translucent.

STREAK: dark red to brown to black.

HARDNESS: 6, can be scratched by a steel file. Heavy weight.

CLEAVAGE: good parallel to side; brittle.

Columbite

Black.

LUSTER: nonmetallic; sparkling to glassy to dull; transparent to translucent to opaque.

STREAK: colorless.

HARDNESS: 9, easily scratches quartz. Heavy weight.

FRACTURE: shell-like to uneven; brittle.

NOTE: may fluoresce in ultraviolet light.

Corundum

BLACK

Black, grayish-black.

LUSTER: nonmetallic; sparkling to dull, greasy; transparent to translucent; opaque in dark colors.

STREAK: colorless

HARDNESS: 10 or over, easily scratches quartz. Medium weight.

CLEAVAGE: perfect in four directions, yielding fragments similar to figure 30; brittle.

NOTE: may fluoresce in ultraviolet light. If a crystal is rubbed, it may generate enough electricity to pick up tiny bits of paper.

Diamond

Black.

LUSTER: nonmetallic; glassy, pearly; transparent, or translucent to opaque.

STREAK: colorless.

HARDNESS: 3½-4, can be scratched by a knife blade, possibly by a copper coin. Medium weight.

CLEAVAGE: good in three directions, yielding fragments similar to figure 21; brittle.

Dolomite

Blackish-green.

LUSTER: nonmetallic; glassy; pearly on cleavage surface; transparent to opaque.

STREAK: colorless to grayish-white.

HARDNESS: 6-7, can be scratched by quartz, possibly by a steel file. Medium weight.

CLEAVAGE: good parallel to length of crystals; brittle.

NOTE: a crystal will show green in one direction and brown in another when held to a light and turned.

Epidote

Blackish.

LUSTER: brilliant metallic; occasionally dull with tarnish; opaque.

STREAK: lead-gray to gray-black.

HARDNESS: 2½, can be scratched by the fingernail; will mark paper. Heavy weight.

CLEAVAGE: good in three directions, yielding cubes similar to figure 31.

NOTE: a small piece held in a candle flame will slowly melt, and small drops of metallic lead will form on the surface.

Galena

Black.

LUSTER: nonmetallic; glassy to resinous; transparent to translucent, occasionally opaque.

STREAK: colorless to white.

HARDNESS: $6\frac{1}{2}$ – $7\frac{1}{2}$, can be scratched by quartz at 7 and under; over 7 will scratch quartz. Heavy weight.

FRACTURE: uneven.

Garnet

Black.

LUSTER: metallic to dull earthy; opaque.

STREAK: black to grayish-black.

HARDNESS: 1–2, easily marks paper, soils fingers; can be cut with a knife. Light weight.

CLEAVAGE: perfect parallel to base, leaving small flakes that are flexible but not elastic.

NOTE: generally feels greasy.

Graphite

Black.

LUSTER: brilliant metallic and translucent in crystalline variety; sub-metallic, dull, opaque in earthy variety.

STREAK: Indian-red to reddish-brown.

HARDNESS: 1– $2\frac{1}{2}$ in soft variety, can be scratched by the fingernail; $5\frac{1}{2}$ – $6\frac{1}{2}$ in harder ore, can be scratched by a steel file, possibly by a knife blade; may scratch glass. Medium weight.

FRACTURE: uneven; brittle.

NOTE: may be slightly magnetic.

Hematite

Black.

LUSTER: nonmetallic; glassy; silky when fibrous; pearly on cleavage surfaces; translucent on thin edges.

BLACK

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STREAK: colorless to grayish.

HARDNESS: 5-6, can be scratched by a steel file, possibly by a knife blade. Medium weight.

CLEAVAGE: perfect in two directions, with cleavage lines meeting at angles of 56° and 124° .

Hornblende

Black.

LUSTER: metallic to submetallic; opaque.

STREAK: black or dark reddish-brown.

HARDNESS: $5\frac{1}{2}$ -6, can be scratched by a steel file. Medium weight.

FRACTURE: shell-like to uneven.

NOTE: may be magnetic.

Ilmenite

Black.

LUSTER: submetallic; glassy; dull to earthy; nearly opaque.

STREAK: yellowish-brown.

HARDNESS: $5-5\frac{1}{2}$, can be scratched by a steel file, possibly by a knife blade. Medium weight.

FRACTURE: granular.

NOTE: generally becomes magnetic after being heated.

Limonite

Iron-black.

LUSTER: metallic, sometimes brilliant; opaque.

STREAK: black.

HARDNESS: $5\frac{1}{2}$ -6, can be scratched by a steel file, possibly by a knife blade. Medium weight.

FRACTURE: uneven; brittle.

NOTE: strongly magnetic; may act as a natural magnet.

Magnetite

Blue-black.

LUSTER: metallic; opaque.

STREAK: dark bluish-gray to greenish-black.

HARDNESS: $1-1\frac{1}{2}$, can be scratched by the fingernail or shaved with a knife; will mark paper. Medium weight.

CLEAVAGE: perfect parallel to base, yielding plates that are flexible but not elastic.

NOTE: feels soapy or greasy; may fluoresce in ultraviolet light.

Molybdenite

Black, possibly showing internal play of colors.

LUSTER: nonmetallic; glassy, waxy, pearly; transparent to translucent to opaque.

STREAK: white to colorless.

HARDNESS: 5-6½, can be scratched by a steel file, possibly by a knife blade; may scratch glass. Light weight.

FRACTURE: shell-like, leaving smooth surface.

NOTE: may fluoresce in ultraviolet light.

Opal

Iron-black.

LUSTER: submetallic to dull; opaque.

STREAK: brownish-black.

HARDNESS: 5-6, can be scratched by a steel file, possibly by a knife blade. Medium weight.

FRACTURE: shell-like, usually smooth; brittle.

Psilomelane

Iron-black.

LUSTER: metallic; opaque.

STREAK: black, sooty.

HARDNESS: 1-2½, will mark paper, soil fingers. Medium weight.

FRACTURE: splintery, uneven, brittle.

Pyrolusite

Near-black.

LUSTER: nonmetallic; glassy in crystals, greasy in rock-like masses; transparent to translucent to opaque.

STREAK: white, colorless, or very light colored.

HARDNESS: 7, can scratch glass and be scratched by quartz. Medium weight.

FRACTURE: shell-like; brittle.

BLACK

NOTE: horizontal lines or grooves on crystals.

Quartz

Black, brownish-black.

LUSTER: brilliant metallic to submetallic; transparent to translucent to opaque.

STREAK: pale brown.

HARDNESS: 6-6½, can be scratched by a steel file; will scratch glass. Heavy weight.

FRACTURE: uneven; brittle.

Rutile

Near-black. Often has a mottled appearance.

LUSTER: nonmetallic; greasy, waxy; silky in fibrous variety; translucent to opaque.

STREAK: white or colorless, possible glassy appearance.

HARDNESS: 2½-4 (5), can be scratched by a copper coin in soft varieties, or by a knife blade. Medium weight.

FRACTURE: splintery to shell-like.

NOTE: feels smooth, sometimes soapy.

Serpentine

Black.

LUSTER: nonmetallic; resinous to sparkling; transparent to translucent to opaque.

STREAK: brown to yellowish to whitish.

HARDNESS: 3½-4, can be scratched by a knife blade. Heavy weight.

CLEAVAGE: perfect in six directions, yielding fragments similar to figure 28.

NOTE: may fluoresce in ultraviolet light.

Sphalerite

Black.

LUSTER: nonmetallic; resinous to sparkling; transparent to translucent to opaque.

STREAK: colorless, white, possible slight reddish tint.

HARDNESS: 5-5½, can be scratched by a steel file, possibly by a knife blade. Medium weight.

CLEAVAGE: two directions, parallel to base and side.

Sphene

Black.

LUSTER: nonmetallic; glassy, sparkling; transparent to translucent, may be opaque in dark colors.

STREAK: white.

HARDNESS: 8, will scratch quartz. Medium weight.

FRACTURE: shell-like; brittle.

Spinel

Brownish-black.

LUSTER: nonmetallic; resinous to dull glassy; translucent to opaque, occasionally transparent.

STREAK: colorless to light gray.

HARDNESS: 7-7½, will scratch quartz. Medium weight.

FRACTURE: shell-like, rough; brittle.

NOTE: a small piece will appear blood-red or orange when held to a light.

Staurolite

Iron-black.

LUSTER: metallic; opaque.

STREAK: iron-black.

HARDNESS: 2-2½, can be scratched by a copper coin. Heavy weight

FRACTURE: roughly shell-like to uneven; very brittle.

NOTE: a small piece will melt in a candle flame.

Stephanite

Black with slight bluish tint.

LUSTER: metallic; brilliant on cleavage surface; opaque.

STREAK: lead-gray to black.

HARDNESS: 2, can be scratched by the fingernail; will mark paper. Medium weight.

CLEAVAGE: perfect along length, leaving polished-looking surface.

NOTE: a small piece will melt in a candle flame.

Stibnite

BLACK

Iron-black, grayish-black.

LUSTER: metallic, often brilliant; opaque.

STREAK: black to brown to reddish.

HARDNESS: 3-4½, can be scratched by a knife blade, possibly by a copper coin. Medium weight.

FRACTURE: uneven; brittle.

Tetrahedrite

Black. May have orange-yellow or brownish-yellow streaks.

LUSTER: nonmetallic; glassy, resinous, greasy; transparent to translucent to opaque.

STREAK: brown to black in thorite, orange-yellow in orange-ite.

HARDNESS: 4½-5, can be scratched by a knife blade. Heavy weight.

FRACTURE: shell-like.

NOTE: radioactive.

Thorite

Black.

LUSTER: nonmetallic; glassy to resinous; transparent to translucent to opaque.

STREAK: colorless.

HARDNESS: 7-7½, will scratch quartz. Medium weight.

FRACTURE: shell-like to uneven; brittle.

NOTE: a crystal will show different colors when held to a light and turned. May fluoresce in ultraviolet light.

Tourmaline

Velvety-black, greenish-black, grayish-black, brownish-black.

May have spots of greenish or yellowish coating.

LUSTER: submetallic; pitchy, dull; opaque.

STREAK: brownish-black, possibly greenish-black or grayish-black.

HARDNESS: 5½, can be scratched by a steel file, possibly by a knife blade. Very heavy weight.

FRACTURE: shell-like to uneven; brittle.

NOTE: strongly radioactive.

Uraninite-Pitchblende

COLOR KEY**BLACK**

Black, brownish-black, grayish-black.

LUSTER: metallic to submetallic; often resinous; opaque.

STREAK: brown to black.

HARDNESS: 5-5½, can be scratched by a steel file, possibly by a knife blade. Very heavy.

CLEAVAGE: perfect parallel to side; brittle.

NOTE: generally bright red color in thin splinters.

Wolframite**BLUE**

Bluish-white, opalescent.

LUSTER: nonmetallic; glassy to pearly; transparent to translucent.

STREAK: colorless.

HARDNESS: 6-6½, can be scratched by quartz, possibly by a steel file. Medium weight.

CLEAVAGE: in two directions, with cleavage lines meeting at an angle of near 90°; brittle.

NOTE: may fluoresce in ultraviolet light.

Albite

Pale-blue, gray-blue.

LUSTER: nonmetallic; glassy; pearly on cleavage surface; translucent to transparent.

STREAK: white.

HARDNESS: 6, can be scratched by a steel file. Medium weight.

CLEAVAGE: perfect parallel to base; brittle.

Amblygonite

Pale-blue.

LUSTER: nonmetallic; glassy; pearly on cleavage surfaces; transparent to translucent.

STREAK: colorless to grayish-white.

HARDNESS: 3-3½, can be scratched by a copper coin and cut with a knife. Medium weight.

CLEAVAGE: good in three directions, with cleavage lines meeting at right angles, yielding rectangular blocks; brittle.

Anhydrite

BLUE

Blue; frequently has patchy or melted appearance.

LUSTER: nonmetallic; glassy, resinous, greasy; transparent to translucent to opaque.

STREAK: colorless to white.

HARDNESS: 5, can be scratched easily by a steel file, possibly by a knife blade. Medium weight.

CLEAVAGE: poor parallel to base and side.

FRACTURE: shell-like; brittle.

NOTE: may fluoresce in ultraviolet light.

Apatite

Plum-blue.

LUSTER: nonmetallic; glassy; transparent to translucent.

STREAK: colorless.

HARDNESS: 6½-7, can be scratched by quartz. Medium weight.

FRACTURE: shell-like.

NOTE: may fluoresce in ultraviolet light.

Axinite

Rich deep blue.

LUSTER: nonmetallic; glassy to sparkling; transparent to translucent.

STREAK: light blue.

HARDNESS: 3½-4, can be scratched by a knife blade. Medium weight.

FRACTURE: shell-like; brittle.

NOTE: frequently feels velvety.

Azurite

Blue.

LUSTER: nonmetallic; glassy; pearly on cleavage surface; transparent to translucent.

STREAK: white or colorless.

HARDNESS: 3-3½, can be scratched by a knife blade, possibly by a copper coin. Heavy weight.

CLEAVAGE: perfect parallel to base; brittle.

NOTE: may fluoresce in ultraviolet light.

Barite

Blue, blue-green.

LUSTER: nonmetallic; glassy; transparent to translucent.

STREAK: colorless.

HARDNESS: 6-6½, can be scratched by quartz. Medium weight.

FRACTURE: shell-like.

NOTE: may fluoresce in ultraviolet light.

Benitoite*Blue-green. May have frosted or mottled appearance.*

LUSTER: nonmetallic; glassy; transparent to translucent, occasionally opaque.

STREAK: white or colorless.

HARDNESS: 7½-8, will scratch quartz. Medium weight.

CLEAVAGE: parallel to base; poor.

FRACTURE: shell-like to uneven; brittle.

Beryl*Blue.*

LUSTER: nonmetallic; glassy to earthy; transparent to translucent.

STREAK: white to gray.

HARDNESS: 3, can be scratched by a copper coin. Medium weight.

CLEAVAGE: perfect in three directions at oblique angles, yielding smooth-surfaced fragments similar to figure 21.

NOTE: will frequently fluoresce in ultraviolet light.

Calcite*Light blue.*

LUSTER: nonmetallic; glassy to pearly; transparent to translucent to opaque.

STREAK: colorless to white.

HARDNESS: 3-3½, can be scratched by a knife blade, possibly by a copper coin. Heavy weight.

CLEAVAGE: perfect parallel to base.

NOTE: may fluoresce in ultraviolet light.

Celestite

BLUE

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Pale-blue, sometimes with dark internal forms; bands of blue and white.

LUSTER: nonmetallic; waxy, glassy, dull; transparent to translucent.

STREAK: colorless.

HARDNESS: 7, can be scratched by quartz. Medium weight

FRACTURE: shell-like; brittle.

NOTE: may fluoresce in ultraviolet light.

Chalcedony

Greenish-blue, sky-blue, usually with black streaks

LUSTER: nonmetallic; glassy to earthy; translucent to opaque

STREAK: light blue to almost white.

HARDNESS: 2-4, can be scratched by a knife blade, possibly by a copper coin. Light weight.

FRACTURE: shell-like.

NOTE: if touched to the tongue, will often stick to it

Chrysocolla

Blue of various shades

LUSTER: nonmetallic; glassy; transparent to translucent

STREAK: colorless.

HARDNESS: 7-7½, will scratch quartz. Medium weight

FRACTURE: shell-like to uneven.

NOTE: some crystals will show various colors when held to a light and turned.

Cordierite

Blue, bluish-gray.

LUSTER: nonmetallic; sparkling to glassy to dull; transparent to translucent to opaque.

STREAK: colorless.

HARDNESS: 9, easily scratches quartz. Heavy weight.

FRACTURE: shell-like to uneven; brittle

NOTE: may fluoresce in ultraviolet light.

Corundum

Indigo blue, frequently iridescent.

LUSTER: metallic; resinous; opaque.

STREAK: grayish-black to black.

HARDNESS: 1½–2, will mark paper. Medium weight.

CLEAVAGE: parallel to base, yielding thin flexible plates.

NOTE: will turn purple when dampened with water.

Covellite

Pale-blue.

LUSTER: nonmetallic; sparkling to dull; greasy; transparent to translucent; opaque in dark colors.

STREAK: colorless.

HARDNESS: 10 or over, easily scratches quartz. Medium weight.

CLEAVAGE: perfect in four directions, yielding fragments similar to figure 30; brittle.

NOTE: may fluoresce in ultraviolet light. If a crystal is rubbed, it may generate enough electricity to pick up tiny bits of paper.

Diamond

Blue, greenish-blue. Very distinctive colors.

LUSTER: nonmetallic; glassy; transparent to translucent.

STREAK: colorless.

HARDNESS: 7, can be scratched by quartz. Medium weight.

CLEAVAGE: parallel to length of fibers; poor

Dumortierite

Blue, bluish-green.

LUSTER: nonmetallic; glassy; transparent to translucent.

STREAK: colorless or white.

HARDNESS: 4, can be scratched by a knife blade. Medium weight.

CLEAVAGE: perfect in four directions, yielding fragments similar to figure 30.

NOTE: will generally fluoresce in ultraviolet light. Crystals and masses may show bands of color.

Fluorite

Blue.

LUSTER: nonmetallic; glassy; transparent to translucent.

BLUE

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STREAK: colorless.

HARDNESS: 2½, can be scratched by a copper coin, possibly by the fingernail. Light weight.

CLEAVAGE: perfect in three directions, yielding small square blocks; somewhat brittle.

NOTE: soluble in water; a small piece will melt in a candle flame. May fluoresce in ultraviolet light.

Halite

Bluish.

LUSTER: nonmetallic; sparkling, glassy, pearly; transparent to translucent.

STREAK: white.

HARDNESS: 4½-5, can be scratched by a knife blade. Medium weight.

CLEAVAGE: parallel to base and side; brittle.

NOTE: will frequently fluoresce in ultraviolet light.

Hemimorphite

Blue, sometimes with white or grayish streaks.

LUSTER: nonmetallic; glassy to resinous; subtranslucent to translucent, occasionally transparent.

STREAK: white.

HARDNESS: 6½, can be scratched by quartz, possibly by a steel file. Medium weight.

FRACTURE: roughly shell-like; brittle.

Idocrase

Blue. May have blotchy appearance.

LUSTER: nonmetallic; glassy to pearly; transparent to translucent.

STREAK: colorless to whitish.

HARDNESS: 5 parallel to length of crystal, can be scratched by a knife blade; 7 across width of crystal, can be scratched by quartz. Medium weight.

CLEAVAGE: perfect parallel to length of crystals.

NOTE: crystals generally darker in color toward the center.

Kyanite

Azure blue.

LUSTER: nonmetallic; glassy; transparent to translucent.

STREAK: white.

HARDNESS: 5-6, can be scratched by a steel file, possibly by a knife blade. Medium weight.

FRACTURE: uneven; brittle.

Lazulite*Azure blue, greenish-blue, violet-blue.*

LUSTER: nonmetallic; glassy; translucent.

STREAK: colorless.

HARDNESS: 5-5½, can be scratched by a knife blade. Medium weight.

FRACTURE: uneven.

Lazurite*Blue-black, lead gray with bluish tone.*

LUSTER: metallic; opaque.

STREAK: dark bluish-gray to greenish-black.

HARDNESS: 1-1½, can be scratched by the fingernail or shaved with a knife; will mark paper. Medium weight.

CLEAVAGE: perfect parallel to base, yielding plates that are flexible but not elastic.

NOTE: feels soapy or greasy; may fluoresce in ultraviolet light.

Molybdenite*Bluish, bluish-white, possibly showing internal play of colors.*

LUSTER: nonmetallic; glassy, waxy, pearly; transparent to translucent to opaque.

STREAK: white to colorless.

HARDNESS: 5-6½, can be scratched by a steel file, possibly by a knife blade; may scratch glass. Light weight.

FRACTURE: shell-like, smooth.

NOTE: may fluoresce in ultraviolet light.

Opal*Bluish-steel-gray.*

LUSTER: metallic; opaque.

BLUE

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STREAK: black, sooty.

HARDNESS: 1-2½, will mark paper, soil fingers. Medium weight.

FRACTURE: splintery, uneven, brittle.

Pyrolusite

Pale bluish-green.

LUSTER: nonmetallic; glassy, satiny; translucent, occasionally transparent.

STREAK: colorless.

HARDNESS: 6-7, can be scratched by quartz, possibly by a steel file. Medium weight.

CLEAVAGE: parallel to length of crystals or fibers.

Sillimanite

Blue, bluish-green.

LUSTER: nonmetallic; glassy; translucent to opaque.

STREAK: colorless to whitish.

HARDNESS: 5, can be scratched by a knife blade. Heavy weight.

CLEAVAGE: good in three directions, yielding fragments similar to figure 21; cleavage lines not always distinct; brittle.

Smithsonite

Blue, bluish-red.

LUSTER: nonmetallic; glassy, sparkling; transparent to translucent, may be opaque in dark colors.

STREAK: white.

HARDNESS: 8, will scratch quartz. Medium weight.

FRACTURE: shell-like; brittle.

Spinel

Black with bluish tint.

LUSTER: metallic; brilliant on cleavage surface; opaque.

STREAK: lead-gray to black.

HARDNESS: 2, can be scratched by the fingernail; will mark paper. Medium weight.

CLEAVAGE: perfect along length, leaving polished-looking surface

NOTE: a small piece will melt in a candle flame.

Stibnite

Bluish.

LUSTER: nonmetallic; glassy; transparent, occasionally translucent.

STREAK: colorless.

HARDNESS: 8, will scratch quartz. Medium weight.

CLEAVAGE: perfect parallel to base; brittle.

NOTE: if a crystal is rubbed, it will generate enough electricity to pick up bits of paper. May fluoresce in ultraviolet light.

Topaz

Blue.

LUSTER: nonmetallic; glassy to resinous; transparent to translucent to opaque.

STREAK: colorless.

HARDNESS: 7-7½, will scratch quartz. Medium weight.

FRACTURE: shell-like to uneven; brittle.

NOTE: a crystal will show different colors when held to a light and turned. May fluoresce in ultraviolet light.

Tourmaline

Blue, bluish-green.

LUSTER: nonmetallic; waxy, dull; faintly translucent to opaque.

STREAK: colorless, whitish, greenish.

HARDNESS: 6, can be scratched by quartz, possibly by a steel file; may scratch glass. Medium weight.

FRACTURE: shell-like smooth.

Turquoise

Blue.

LUSTER: nonmetallic; glassy to resinous; transparent to translucent.

STREAK: colorless.

HARDNESS: 5½, can be scratched by a steel file, possibly by a knife blade. Heavy weight.

BROWN

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FRACTURE: shell-like to uneven; brittle.

NOTE: may show flashes of light when struck with a hammer or scratched with a sharp instrument. Highly fluorescent in ultraviolet light.

Willemite

BROWN

Brownish-black. May have yellow-brown coating.

LUSTER: nonmetallic; resinous, pitchy; translucent on thin edges.

STREAK: colorless to brownish.

HARDNESS: 5½-6, can be scratched by a steel file. Medium weight.

FRACTURE: roughly shell-like to uneven; brittle.

NOTE: slightly radioactive.

Allanite

Brown, reddish-brown.

LUSTER: nonmetallic; glassy; translucent to opaque, occasionally transparent.

STREAK: colorless.

HARDNESS: 7½, can scratch quartz. Medium weight

FRACTURE: uneven; brittle.

NOTE: some crystals will show red in one direction and green in another when held to a light and turned.

Andalusite

Pale brown.

LUSTER: nonmetallic; diamond-like sparkle when crystalline, dull when earthy; transparent to opaque.

STREAK: colorless.

HARDNESS: 3, can be scratched by a copper coin. Very heavy

CLEAVAGE: parallel to base and side; poor.

FRACTURE: shell-like; brittle.

NOTE: may fluoresce in ultraviolet light.

Anglesite

Brown; frequently has patchy or melted appearance.

LUSTER: nonmetallic; glassy, resinous, greasy; transparent to translucent to opaque.

STREAK: colorless to white.

HARDNESS: 5, can be scratched easily by a steel file, possibly by a knife blade. Medium weight.

CLEAVAGE: parallel to base and side; poor.

FRACTURE: shell-like; brittle.

NOTE: may fluoresce in ultraviolet light.

Apatite

Brown.

LUSTER: nonmetallic; glassy; transparent to translucent to opaque.

STREAK: colorless.

HARDNESS: $3\frac{1}{2}$ –4, can be scratched by a knife blade. Medium weight.

CLEAVAGE: parallel to length of crystals or columns; poor.

FRACTURE: shell-like to uneven; brittle.

NOTE: will become powdery when held in a candle flame. May fluoresce in ultraviolet light.

Aragonite

Brown, clove-brown.

LUSTER: nonmetallic; glassy; transparent to translucent.

STREAK: colorless.

HARDNESS: $6\frac{1}{2}$ –7, can be scratched by quartz. Medium weight.

FRACTURE: shell-like.

NOTE: may fluoresce in ultraviolet light.

Axinite

Brown.

LUSTER: nonmetallic; dull, earthy; translucent to opaque.

STREAK: colorless.

HARDNESS: 1–3, can be scratched by a copper coin, possibly by the fingernail. Medium weight.

FRACTURE: earthy.

NOTE: may fluoresce in ultraviolet light.

Bauxite

Dark brown.

LUSTER: nonmetallic; glassy, shining; pearly on cleavage surfaces; transparent in very thin plates, and translucent, possibly opaque, in thicker plates.

STREAK: colorless.

HARDNESS: $2\frac{1}{2}$ -3, can be scratched by a copper coin, possibly by the fingernail. Medium weight.

CLEAVAGE: perfect parallel to base, separating easily into very thin elastic plates of light gray color.

Biotite

Reddish-brown to brownish-bronze on fresh fracture; purple tarnish on exposure to air.

LUSTER: metallic; opaque.

STREAK: gray-black to black.

HARDNESS: 3, can be scratched by a knife blade, possibly by a copper coin. Medium weight.

FRACTURE: uneven; brittle.

Bornite

Brown.

LUSTER: nonmetallic; glassy to earthy; transparent to translucent.

STREAK: white to gray.

HARDNESS: 3, can be scratched by a copper coin. Medium weight.

CLEAVAGE: perfect in three directions at oblique angles, yielding smooth-surfaced fragments similar to figure 21.

NOTE: will frequently fluoresce in ultraviolet light.

Calcite

Brown.

LUSTER: nonmetallic; brilliant sparkle in crystals to dull in masses; translucent to opaque, rarely transparent.

STREAK: white to very pale brown.

HARDNESS: 6-7, can be scratched by quartz, possibly by a steel file. Very heavy.

FRACTURE: rough, uneven.

Cassiterite

Brownish.

LUSTER: nonmetallic; diamond-like sparkle; transparent to translucent.

STREAK: white or colorless.

HARDNESS: 3-3½, can be scratched by a knife blade, possibly by a copper coin. Very heavy.

FRACTURE: shell-like; very brittle.

NOTE: a small splinter can be melted in a candle flame.

Cerussite

Brown, reddish-brown, bands of brown and white.

LUSTER: nonmetallic; waxy, glassy, dull; transparent to translucent.

STREAK: colorless.

HARDNESS: 7, can be scratched by quartz. Medium weight.

FRACTURE: shell-like; brittle.

NOTE: may fluoresce in ultraviolet light.

Chalcedony

Brown-black.

LUSTER: submetallic to metallic; frequently pitchy; translucent to opaque.

STREAK: brown.

HARDNESS: 5½, can be scratched by a steel file, possibly by a knife blade. Medium weight.

FRACTURE: uneven; brittle.

NOTE: may be slightly magnetic.

Chromite

Brown, brownish-green.

LUSTER: nonmetallic; glassy; transparent to translucent.

STREAK: colorless.

HARDNESS: 8½, easily scratches quartz. Medium weight.

CLEAVAGE: two directions, with cleavage lines meeting at right angles; brittle.

Chrysoberyl

Brown.

LUSTER: nonmetallic; glassy to earthy; translucent to opaque.

BROWN

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STREAK: light blue to almost white.

HARDNESS: 2-4, can be scratched by a knife blade, possibly by a copper coin. Light weight.

FRACTURE: shell-like.

NOTE: if touched to the tongue, will often stick to it.

Chrysocolla

Reddish-brown.

LUSTER: nonmetallic; diamond-like sparkle to dull; transparent to translucent.

STREAK: scarlet to dark red.

HARDNESS: 2-2½, can be scratched by the fingernail. Heavy weight.

CLEAVAGE: perfect in two directions, with cleavage lines meeting at right angles.

Cinnabar

Brownish-black, reddish-brown.

LUSTER: submetallic; resinous; bluish tint on fresh fracture; opaque to faintly translucent.

STREAK: dark red to brown to black.

HARDNESS: 6, can be scratched by a steel file. Heavy weight.

CLEAVAGE: good parallel to side; brittle.

Columbite

Copper-brown, often with green spots, or black with tarnish.

LUSTER: metallic; dull when tarnished; opaque.

STREAK: copper-red.

HARDNESS: 2½-3, can be scratched by a knife blade, possibly by a copper coin; malleable, can be twisted with tools. Very heavy.

FRACTURE: rough, hackly.

Copper

Brown.

LUSTER: nonmetallic; sparkling to glassy to dull; transparent to translucent to opaque.

STREAK: colorless.

HARDNESS: 9, easily scratches quartz. Heavy weight.

FRACTURE: shell-like to uneven; brittle.

NOTE: may fluoresce in ultraviolet light.

Corundum

Reddish-brown, often with green or blue spots.

LUSTER: metallic; clear crystals have diamond-like sparkle; transparent to translucent.

STREAK: brownish-red to brick-red.

HARDNESS: $3\frac{1}{2}$ –4, can be scratched by a knife blade. Medium weight.

FRACTURE: uneven; brittle.

Cuprite

Light brown.

LUSTER: nonmetallic; sparkling to dull; greasy; transparent to translucent; opaque in dark colors.

STREAK: colorless.

HARDNESS: 10 or over, easily scratches quartz. Medium weight.

CLEAVAGE: perfect in four directions, yielding fragments similar to figure 30; brittle.

NOTE: may fluoresce in ultraviolet light. If a crystal is rubbed, it may generate enough electricity to pick up tiny bits of paper.

Diamond

Brown.

LUSTER: nonmetallic; glassy, pearly; transparent, or translucent to opaque.

STREAK: colorless.

HARDNESS: $3\frac{1}{2}$ –4, can be scratched by a knife blade, possibly by a copper coin. Medium weight.

CLEAVAGE: good in three directions, yielding fragments similar to figure 21; brittle.

Dolomite

Brownish-green.

LUSTER: nonmetallic; glassy; pearly on cleavage surface; transparent to opaque.

STREAK: colorless to grayish-white.

BROWN

THE ROCK-HUNTER'S FIELD MANUAL

HARDNESS: 6-7, can be scratched by quartz, possibly by a steel file. Medium weight.

CLEAVAGE: good parallel to length of crystals; brittle.

NOTE: a crystal will show green in one direction and brown in another when held to a light and turned.

Epidote

Brown.

LUSTER: nonmetallic; glassy; transparent to translucent.

STREAK: colorless or white.

HARDNESS: 4, can be scratched by a knife blade. Medium weight.

CLEAVAGE: perfect in four directions, yielding fragments similar to figure 30.

NOTE: will generally fluoresce in ultraviolet light.

Fluorite

Brown, reddish-brown.

LUSTER: nonmetallic; glassy to resinous; transparent to translucent, occasionally opaque.

STREAK: colorless to white.

HARDNESS: 6½-7½; can be scratched by quartz at 7 and under; over 7 will scratch quartz. Heavy weight.

FRACTURE: uneven.

Garnet

Brown.

LUSTER: nonmetallic; glassy, silky, or pearly; transparent to translucent to opaque.

STREAK: colorless to white.

HARDNESS: 1½-2, can be scratched by the fingernail. Medium weight.

CLEAVAGE: perfect parallel to side of crystals.

NOTE: may fluoresce in ultraviolet light.

Gypsum

Brown, reddish-brown.

LUSTER: brilliant metallic and translucent in crystalline variety; submetallic, dull, opaque in earthy variety.

STREAK: Indian-red to reddish-brown.

HARDNESS: 1-2½ in soft variety, can be scratched by the fingernail; 5½-6½ in harder ore, can be scratched by a steel file, possibly by a knife blade; may scratch glass. Medium weight.

FRACTURE: uneven; brittle.

NOTE: may be slightly magnetic.

Hematite

Brown.

LUSTER: nonmetallic; sparkling, glassy, pearly; transparent to translucent.

STREAK: white.

HARDNESS: 4½-5, can be scratched by a knife blade. Medium weight.

CLEAVAGE: parallel to base and side; brittle.

NOTE: will frequently fluoresce in ultraviolet light.

Hemimorphite

Brownish.

LUSTER: nonmetallic; glassy; silky when fibrous; pearly on cleavage surfaces; translucent on thin edges.

STREAK: colorless to grayish.

HARDNESS: 5-6, can be scratched by a steel file, possibly by a knife blade. Medium weight.

CLEAVAGE: perfect in two directions, with cleavage lines meeting at angles of 56° and 124°.

Hornblende

Brown, sometimes with white or grayish streaks.

LUSTER: nonmetallic; glassy to resinous; subtranslucent to translucent, occasionally transparent.

STREAK: white.

HARDNESS: 6½, can be scratched by quartz, possibly by a steel file. Medium weight.

FRACTURE: roughly shell-like; brittle.

Idocrase

Light brown coating.

LUSTER: nonmetallic; waxy, glassy, pearly; translucent to opaque.

BROWN

STREAK: colorless.

HARDNESS: 6½-7, may be scratched by quartz. Medium weight.

CLEAVAGE: fair parallel to base and side, with cleavage lines meeting at an angle of near 90°.

FRACTURE: splintery, may be hard to break.

Jadeite

Brown.

LUSTER: nonmetallic; dull earthy; pearly in plates; opaque in masses.

STREAK: white.

HARDNESS: 2-2½, can be scratched by the fingernail. Medium weight.

CLEAVAGE: parallel to base, yielding thin flexible plates.

NOTE: feels smooth, greasy; has strong clay odor when slightly damp.

Kaolinite

Dark brown, brownish-yellow.

LUSTER: submetallic; glassy; dull to earthy; nearly opaque.

STREAK: yellowish-brown.

HARDNESS: 5-5½, can be scratched by a steel file, possibly by a knife blade. Medium weight.

FRACTURE: granular.

NOTE: generally becomes magnetic after being heated.

Limonite

Yellow-brown tarnish.

LUSTER: metallic; opaque.

STREAK: grayish-black to brownish-black.

HARDNESS: 6-6½, can be scratched by a steel file; may scratch glass. Medium weight.

FRACTURE: uneven; brittle.

Marcasite

Brown.

LUSTER: nonmetallic; glassy to dull; transparent to opaque.

STREAK: white to colorless.

COLOR KEY**BROWN**

HARDNESS: $3\frac{1}{2}$ –5, can be scratched by a knife blade. Medium weight.

CLEAVAGE: three perfect with cleavage lines meeting at oblique angles in crystalline variety.

FRACTURE: shell-like in noncrystalline variety; brittle.

Magnesite

Brown, yellowish-brown, reddish-brown.

LUSTER: nonmetallic; glassy to resinous; transparent to translucent, occasionally opaque.

STREAK: colorless to yellowish or brownish.

HARDNESS: 5– $5\frac{1}{2}$, can be scratched by a knife blade. Heavy weight.

FRACTURE: shell-like to uneven; brittle.

NOTE: radioactive.

Monazite

Pale brown.

LUSTER: nonmetallic; glassy, pearly, silky; transparent to translucent.

STREAK: colorless.

HARDNESS: 2– $2\frac{1}{2}$, can be scratched by the fingernail. Medium weight.

CLEAVAGE: perfect parallel to base, yielding very thin flexible and elastic plates.

Muscovite

Brown.

LUSTER: nonmetallic; glassy; transparent to translucent.

STREAK: colorless.

HARDNESS: $6\frac{1}{2}$ –7, can be scratched by quartz. Medium weight.

FRACTURE: shell-like; brittle.

Olivine

Brown, light brown.

LUSTER: nonmetallic; glassy, waxy, pearly; transparent to translucent to opaque.

STREAK: white to colorless.

BROWN

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HARDNESS: 5-6½, can be scratched by a steel file, possibly by a knife blade; may scratch glass. Light weight.

FRACTURE: shell-like, leaving smooth surface.

NOTE: may fluoresce in ultraviolet light.

Opal

Light bronze-brown.

LUSTER: metallic; opaque.

STREAK: brownish-bronze.

HARDNESS: 3½-4, can be scratched by a knife blade
Medium weight.

FRACTURE: shell-like; brittle.

Pentlandite

Light brown.

LUSTER: nonmetallic; glassy; translucent, occasionally transparent.

STREAK: colorless.

HARDNESS: 6-6½, can be scratched by quartz, possibly by a steel file. Medium weight.

FRACTURE: rough, uneven; brittle.

Prehnite

Brownish-bronze.

LUSTER: metallic; opaque.

STREAK: grayish-black to black.

HARDNESS: 3½-4½, can be scratched by a knife blade
Medium weight.

FRACTURE: uneven; brittle.

NOTE: magnetic.

Pyrrhotite

Brown, smoky-brown, yellowish-brown.

LUSTER: nonmetallic; glassy in crystals, greasy in rock-like masses; transparent to translucent to opaque.

STREAK: white, colorless, or very light colored.

HARDNESS: 7, can scratch glass and be scratched by quartz.
Medium weight.

FRACTURE: shell-like; brittle.

NOTE: horizontal lines or grooves on crystals.

Quartz

Brown.

LUSTER: nonmetallic; glassy to pearly; transparent to translucent to opaque.

STREAK: white to colorless.

HARDNESS: $3\frac{1}{2}$ – $4\frac{1}{2}$, can be scratched by a knife blade. Medium weight.

CLEAVAGE: perfect in three directions, with cleavage lines meeting at oblique angles.

Rhodochrosite

Brown.

LUSTER: nonmetallic; glassy to pearly; transparent to translucent to opaque.

STREAK: colorless to white, or very slightly colored.

HARDNESS: $5\frac{1}{2}$ –6, can be scratched by a steel file, possibly by a knife blade. Medium weight.

CLEAVAGE: good in two directions, with cleavage lines meeting at an angle of near 90° .

Rhodonite

Brown, reddish-brown, brownish-black.

LUSTER: brilliant metallic to submetallic; transparent to translucent to opaque.

STREAK: pale brown.

HARDNESS: 6– $6\frac{1}{2}$, can be scratched by a steel file; will scratch glass. Heavy weight.

FRACTURE: uneven; brittle.

Rutile

Brown.

LUSTER: nonmetallic; glassy to sparkling; translucent, occasionally transparent.

STREAK: colorless to white.

HARDNESS: $4\frac{1}{2}$ –5, can be scratched by a knife blade. Very heavy.

CLEAVAGE: parallel to the pyramid; good.

BROWN

NOTE: highly fluorescent in ultraviolet light.

Scheelite

Pale brown, yellowish-brown, brownish-green. Often has a mottled appearance.

LUSTER: nonmetallic; greasy, waxy; silky in fibrous variety; translucent to opaque.

STREAK: white or colorless, possible glassy appearance

HARDNESS: $2\frac{1}{2}$ –4 (5), can be scratched by a copper coin in soft varieties, or by a knife blade. Medium weight.

FRACTURE: splintery to shell-like.

NOTE: feels smooth, sometimes soapy.

Serpentine

Light to dark brown.

LUSTER: nonmetallic; glassy to pearly; transparent to translucent.

STREAK: white to colorless.

HARDNESS: $3\frac{1}{2}$ –4, can be scratched by a knife blade. Heavy weight.

CLEAVAGE: perfect in three directions, with cleavage lines meeting at oblique angles; brittle.

NOTE: will become magnetic after being heated in a candle flame.

Siderite

Brown, grayish-brown.

LUSTER: nonmetallic; glassy, satiny; translucent, occasionally transparent.

STREAK: colorless.

HARDNESS: 6–7, can be scratched by quartz, possibly by a steel file. Medium weight.

CLEAVAGE: parallel to length of crystals or fibers.

Sillimanite

Brownish.

LUSTER: nonmetallic; glassy; translucent to opaque.

STREAK: colorless to whitish.

HARDNESS: 5, can be scratched by a knife blade. Heavy weight.

CLEAVAGE: good in three directions, yielding fragments similar to figure 21; cleavage lines not always distinct; brittle.

Smithsonite

Brown, yellow-brown.

LUSTER: nonmetallic; resinous to sparkling; transparent to translucent to opaque.

STREAK: brown to yellowish to whitish.

HARDNESS: 3½–4, can be scratched by a knife blade. Heavy weight.

CLEAVAGE: perfect in six directions, yielding fragments similar to figure 28.

NOTE: may fluoresce in ultraviolet light.

Sphalerite

Brown.

LUSTER: nonmetallic; resinous to sparkling; transparent to translucent to opaque.

STREAK: colorless, white, possible slight reddish tint.

HARDNESS: 5–5½, can be scratched by a steel file, possibly by a knife blade. Medium weight.

CLEAVAGE: two directions, parallel to base and side.

Sphene

Dark brown, yellowish-brown, greenish-brown.

LUSTER: nonmetallic; glassy, sparkling; transparent to translucent, may be opaque in dark colors.

STREAK: white.

HARDNESS: 8, will scratch quartz. Medium weight.

FRACTURE: shell-like; brittle.

Spinel

Dark brown, brownish-black, yellowish-brown, reddish-brown.

LUSTER: nonmetallic; resinous to dull glassy; translucent to opaque, occasionally transparent.

STREAK: colorless to light gray.

HARDNESS: 7–7½, will scratch quartz. Medium weight.

FRACTURE: shell-like, rough; brittle.

BROWN

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NOTE: a small piece will appear blood-red or orange when held to a light.

Staurolite

Brown, yellowish-brown.

LUSTER: nonmetallic; glassy; pearly on cleavage surface; translucent, occasionally transparent.

STREAK: colorless.

HARDNESS: $3\frac{1}{2}$ –4, can be scratched by a knife blade. Light weight.

CLEAVAGE: parallel to length.

Stilbite

Brownish-yellow.

LUSTER: nonmetallic; resinous; transparent to translucent.

STREAK: pale yellow to white.

HARDNESS: $1\frac{1}{2}$ – $2\frac{1}{2}$, can be scratched by the fingernail and easily cut with a knife. Light weight.

FRACTURE: shell-like to uneven; brittle.

NOTE: if a crystal is rubbed, it may generate enough electricity to pick up tiny bits of paper.

Sulphur

Brownish, brownish-yellow. May have orange-yellow streaks.

LUSTER: nonmetallic; glassy, resinous, greasy; transparent to translucent to opaque.

STREAK: brown to black in thorite, orange-yellow in orange-ite.

HARDNESS: $4\frac{1}{2}$ –5, can be scratched by a knife blade. Heavy weight.

FRACTURE: shell-like.

NOTE: radioactive.

Thorite

Yellowish-brown.

LUSTER: nonmetallic; glassy; transparent, occasionally translucent.

STREAK: colorless.

HARDNESS: 8, will scratch quartz. Medium weight.

CLEAVAGE: perfect parallel to base; brittle.

NOTE: if a crystal is rubbed, it will generate enough electricity to pick up bits of paper. May fluoresce in ultraviolet light.

Topaz

Brown.

LUSTER: nonmetallic; glassy to resinous; transparent to translucent to opaque.

STREAK: colorless.

HARDNESS: 7-7½, will scratch quartz. Medium weight.

FRACTURE: shell-like to uneven; brittle.

NOTE: a crystal will show different colors when held to a light and turned. May fluoresce in ultraviolet light.

Tourmaline

Brownish-black. May have spots of greenish or yellowish coating.

LUSTER: submetallic; pitchy, dull; opaque.

STREAK: brownish-black, possibly greenish-black or grayish-black.

HARDNESS: 5½, can be scratched by a steel file, possibly by a knife blade. Very heavy.

FRACTURE: shell-like to uneven; brittle.

NOTE: strongly radioactive.

Uraninite-Pitchblende

Brown, yellowish-brown, reddish-brown.

LUSTER: nonmetallic; resinous to sparkling; translucent to opaque, occasionally transparent.

STREAK: colorless to yellowish or white.

HARDNESS: 3, can be scratched by a copper coin. Heavy weight.

FRACTURE: rough, uneven; brittle.

Vanadinite

Brown, reddish-brown.

LUSTER: nonmetallic; glassy to resinous; transparent to translucent.

STREAK: colorless.

BROWN

THE ROCK-HUNTER'S FIELD MANUAL

HARDNESS: 5½, can be scratched by a steel file, possibly by a knife blade. Heavy weight.

FRACTURE: shell-like to uneven; brittle.

NOTE: may show flashes of light when struck with a hammer or scratched with a sharp instrument. Highly fluorescent in ultraviolet light.

Willemite

Dark brown, brownish-black brownish-red.

LUSTER: metallic to submetallic; often resinous; opaque.

STREAK: brown to black.

HARDNESS: 5-5½, can be scratched by a steel file, possibly by a knife blade. Very heavy.

CLEAVAGE: perfect parallel to side; brittle.

NOTE: bright red in thin splinters.

Wolframite

Brown.

LUSTER: nonmetallic; glassy; silky when fibrous; pearly on cleavage surface; faintly transparent to translucent.

STREAK: colorless to whitish to grayish.

HARDNESS: 4½-5, can be scratched by a knife blade. Medium weight.

CLEAVAGE: parallel to front and base; brittle.

NOTE: may fluoresce in ultraviolet light.

Wollastonite

Brown, reddish-brown.

LUSTER: nonmetallic; diamond-like sparkle; translucent to opaque, occasionally transparent.

STREAK: colorless.

HARDNESS: 7½, will scratch quartz. Heavy weight.

FRACTURE: shell-like; brittle.

Zircon

Brown.

LUSTER: nonmetallic; glassy, pearly on cleavage surface; transparent to translucent.

STREAK: colorless.

COLOR KEY**COLORLESS**

HARDNESS: 6–6½, can be scratched by quartz, possibly by a steel file. Medium weight.

CLEAVAGE: parallel to length; brittle.

NOTE: may fluoresce in ultraviolet light.

Zoisite**COLORLESS**

Colorless, may show bluish-white opalescence.

LUSTER: nonmetallic; glassy to pearly; transparent to translucent.

STREAK: colorless.

HARDNESS: 6–6½, can be scratched by quartz, possibly by a steel file. Medium weight.

CLEAVAGE: in two directions, with cleavage lines meeting at an angle of near 90°; brittle.

NOTE: may fluoresce in ultraviolet light.

Albite

Colorless.

LUSTER: nonmetallic; glassy; transparent to translucent.

STREAK: colorless.

HARDNESS: 5–5½, can be scratched by a steel file, possibly by a knife blade. Medium weight.

FRACTURE: usually even; brittle.

NOTE: when rubbed or slightly heated, the crystals may generate enough electricity to pick up tiny bits of paper

Analcite

Colorless.

LUSTER: nonmetallic; glassy; translucent to opaque, occasionally transparent.

STREAK: colorless.

HARDNESS: 7½, can scratch quartz. Medium weight.

FRACTURE: uneven; brittle.

NOTE: some crystals will show red in one direction and green in another when held to a light and turned

Andalusite

Colorless.

LUSTER: nonmetallic; diamond-like sparkle when crystalline, dull when earthy; transparent to opaque.

STREAK: colorless.

HARDNESS: 3, can be scratched by a copper coin. Very heavy

CLEAVAGE: parallel to base and side; poor.

FRACTURE: shell-like; brittle.

NOTE: may fluoresce in ultraviolet light.

Anglesite*Colorless.*

LUSTER: nonmetallic; glassy; pearly on cleavage surfaces; transparent to translucent.

STREAK: colorless to grayish-white.

HARDNESS: 3-3½, can be scratched by a copper coin and cut with a knife. Medium weight.

CLEAVAGE: good in three directions, with cleavage lines meeting at right angles, yielding rectangular blocks; brittle.

Anhydrite*Colorless; frequently has patchy or melted appearance.*

LUSTER: nonmetallic; glassy, resinous, greasy; transparent to translucent to opaque.

STREAK: colorless to white.

HARDNESS: 5, can be scratched easily by a steel file, possibly by a knife blade. Medium weight.

CLEAVAGE: parallel to base and side; poor.

FRACTURE: shell-like; brittle.

NOTE: may fluoresce in ultraviolet light.

Apatite*Colorless.*

LUSTER: nonmetallic; glassy; transparent to translucent to opaque.

STREAK: colorless.

HARDNESS: 3½-4, can be scratched by a knife blade. Medium weight.

CLEAVAGE: parallel to length of crystals or columns; poor.

FRACTURE: shell-like to uneven; brittle.

COLOR KEY**COLORLESS**

NOTE: will become powdery when held in a candle flame.
May fluoresce in ultraviolet light.

Aragonite

Colorless.

LUSTER: nonmetallic; glassy; pearly on cleavage surface; transparent to translucent.

STREAK: white or colorless.

HARDNESS: 3–3½, can be scratched by a knife blade, possibly by a copper coin. Heavy weight.

CLEAVAGE: perfect parallel to base; brittle.

NOTE: may fluoresce in ultraviolet light.

Barite

Colorless.

LUSTER: nonmetallic; glassy; transparent to translucent.

STREAK: colorless.

HARDNESS: 6–6½, can be scratched by quartz. Medium weight.

FRACTURE: shell-like.

NOTE: may fluoresce in ultraviolet light.

Benitoite

Colorless; may have frosted or mottled appearance.

LUSTER: nonmetallic; glassy; transparent to translucent, occasionally opaque.

STREAK: white or colorless.

HARDNESS: 7½–8, will scratch quartz. Medium weight.

CLEAVAGE: parallel to base; poor.

FRACTURE: shell-like to uneven; brittle.

Beryl

Colorless.

LUSTER: nonmetallic; glassy; pearly, dull; translucent to opaque.

STREAK: white.

HARDNESS: 2–2½, can be scratched by a copper coin. Light weight.

CLEAVAGE: parallel to front of crystal.

COLORLESS

NOTE: soluble in water; will melt in a candle flame. May fluoresce in ultraviolet light.

Borax

Colorless.

LUSTER: nonmetallic; glassy to earthy; transparent to translucent.

STREAK: white to gray.

HARDNESS: 3, can be scratched by a copper coin. Medium weight.

CLEAVAGE: perfect in three directions at oblique angles, yielding smooth-surfaced fragments similar to figure 21.

NOTE: will frequently fluoresce in ultraviolet light.

Calcite

Colorless.

LUSTER: nonmetallic; glassy to pearly; transparent to translucent to opaque.

STREAK: colorless to white.

HARDNESS: 3-3½, can be scratched by a knife blade, possibly by a copper coin. Heavy weight.

CLEAVAGE: perfect parallel to base.

NOTE: may fluoresce in ultraviolet light.

Celestite

Colorless.

LUSTER: nonmetallic; diamond-like sparkle; transparent to translucent.

STREAK: white or colorless.

HARDNESS: 3-3½, can be scratched by a knife blade, possibly by a copper coin. Very heavy.

FRACTURE: shell-like; very brittle.

NOTE: a small splinter can be melted in a candle flame.

Cerussite.

Colorless.

LUSTER: nonmetallic; glassy; transparent to translucent.

STREAK: white or colorless.

HARDNESS: 4-4½, can be scratched by a knife blade. Medium weight.

CLEAVAGE: good parallel to length; brittle.

NOTE: may break apart in a candle flame; may fluoresce in ultraviolet light.

Colemanite

Colorless.

LUSTER: nonmetallic; sparkling to glassy to dull; transparent to translucent to opaque.

STREAK: colorless.

HARDNESS: 9, easily scratches quartz. Heavy weight.

FRACTURE: shell-like to uneven; brittle.

NOTE: may fluoresce in ultraviolet light.

Corundum

Colorless.

LUSTER: nonmetallic; sparkling to dull; greasy; transparent to translucent; opaque in dark colors.

STREAK: colorless.

HARDNESS: 10 or over, easily scratches quartz. Medium weight.

CLEAVAGE: perfect in four directions, yielding fragments similar to figure 30; brittle.

NOTE: may fluoresce in ultraviolet light. If a crystal is rubbed, it may generate enough electricity to pick up tiny bits of paper.

Diamond

Colorless.

LUSTER: nonmetallic; glassy to dull; translucent, occasionally transparent.

STREAK: colorless.

HARDNESS: 5-6, can be scratched by a steel file, possibly by a knife blade. Medium weight.

CLEAVAGE: fair parallel to base and side, with cleavage lines meeting at an angle of near 90°.

Diopside

Colorless.

LUSTER: nonmetallic; glassy, pearly, transparent, or translucent to opaque.

COLORLESS

STREAK: colorless.

HARDNESS: $3\frac{1}{2}$ –4, can be scratched by a knife blade, possibly by a copper coin. Medium weight.

CLEAVAGE: good in three directions, yielding fragments similar to figure 21; brittle.

Dolomite

Colorless.

LUSTER: nonmetallic; glassy to resinous; transparent to translucent, occasionally opaque.

STREAK: colorless to white.

HARDNESS: $6\frac{1}{2}$ – $7\frac{1}{2}$, can be scratched by quartz at 7 and under; over 7 will scratch quartz. Heavy weight.

FRACTURE: uneven.

Garnet

Colorless.

LUSTER: nonmetallic glassy, silky, or pearly, transparent to translucent to opaque.

STREAK: colorless to white.

HARDNESS: $1\frac{1}{2}$ –2, can be scratched by the fingernail. Medium weight.

CLEAVAGE: perfect parallel to side of crystal.

NOTE: may fluoresce in ultraviolet light.

Gypsum

Colorless.

LUSTER: nonmetallic; glassy; transparent to translucent.

STREAK: colorless.

HARDNESS: $2\frac{1}{2}$, can be scratched by a copper coin, possibly by the fingernail. Light weight.

CLEAVAGE: perfect in three directions, yielding small square blocks; somewhat brittle.

NOTE: soluble in water; a small piece will melt in a candle flame. May fluoresce in ultraviolet light.

Halite

Colorless.

LUSTER: nonmetallic; sparkling, glassy, pearly; transparent to translucent.

STREAK: white

HARDNESS: 4½–5, can be scratched by a knife blade. Medium weight.

CLEAVAGE: parallel to base and side; brittle.

NOTE: will frequently fluoresce in ultraviolet light.

Hemimorphite

Colorless.

LUSTER: nonmetallic; glassy to pearly; transparent to translucent.

STREAK: colorless to white.

HARDNESS: 3, can be scratched by a copper coin. Light weight.

CLEAVAGE: parallel to side and base, yielding long splinters.

NOTE: soluble in water.

Kernite

Colorless.

LUSTER: nonmetallic; glassy, pearly, silky; transparent to translucent.

STREAK: colorless.

HARDNESS: 2–2½, can be scratched by the fingernail. Medium weight.

CLEAVAGE: perfect parallel to base, yielding very thin flexible and elastic plates.

Muscovite

Colorless.

LUSTER: nonmetallic; glassy; transparent to translucent.

STREAK: colorless.

HARDNESS: 5–5½, can be scratched by a knife blade. Light weight.

CLEAVAGE: parallel to base and side.

Natrolite

Colorless, possibly showing internal play of colors.

LUSTER: nonmetallic; glassy, waxy, pearly; transparent to translucent to opaque.

COLORLESS

STREAK: white to colorless.

HARDNESS: 5-6½, can be scratched by a steel file, possibly by a knife blade; may scratch glass. Light weight.

FRACTURE: shell-like, leaving smooth surface.

NOTE: may fluoresce in ultraviolet light.

Opal

Colorless. May show bluish-white opalescence.

LUSTER: nonmetallic; glassy, waxy; transparent to translucent.

STREAK: white.

HARDNESS: 6, can be scratched by a steel file. Medium weight.

CLEAVAGE: parallel to base and side, with cleavage lines meeting at a 90° angle.

Orthoclase

Colorless. May show bright internal scales, or appearance of inner scratches.

LUSTER: nonmetallic; glassy in crystals, greasy in rock-like masses; transparent to translucent to opaque.

STREAK: white, colorless, or very light colored.

HARDNESS: 7, can scratch glass and be scratched by quartz. Medium weight.

FRACTURE: shell-like; brittle.

NOTE: horizontal lines or grooves on crystals.

Quartz

Colorless.

LUSTER: nonmetallic; glassy; transparent, occasionally translucent.

STREAK: colorless.

HARDNESS: 8, will scratch quartz. Medium weight.

CLEAVAGE: perfect parallel to base; brittle.

NOTE: if a crystal is rubbed, it will generate enough electricity to pick up tiny bits of paper. May fluoresce in ultraviolet light.

Topaz

Colorless.

LUSTER: nonmetallic; glassy to resinous; transparent to translucent to opaque.

STREAK: colorless.

HARDNESS: 7-7½, will scratch quartz. Medium weight.

FRACTURE: shell-like to uneven; brittle.

NOTE: a crystal will show different colors when held to a light and turned. May fluoresce in ultraviolet light.

Tourmaline*Colorless.*

LUSTER: nonmetallic; diamond-like sparkle; translucent to opaque, occasionally transparent.

STREAK: colorless.

HARDNESS: 7½, will scratch quartz. Heavy weight.

FRACTURE: shell-like; brittle.

Zircon

GRAY

Gray. May show bluish-white opalescence.

LUSTER: nonmetallic; glassy to pearly; transparent to translucent.

STREAK: colorless.

HARDNESS: 6-6½, can be scratched by quartz, possibly by a steel file. Medium weight.

CLEAVAGE: in two directions, with cleavage lines meeting at an angle of near 90°; brittle.

NOTE: may fluoresce in ultraviolet light.

Albite*Gray-blue, gray-green.*

LUSTER: nonmetallic; glassy; pearly on cleavage surface; translucent to transparent.

STREAK: white.

HARDNESS: 6, can be scratched by a steel file. Medium weight.

CLEAVAGE: perfect parallel to base; brittle.

Amblygonite

GRAY

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Gray.

LUSTER: nonmetallic; glassy; translucent to opaque, occasionally transparent.

STREAK: colorless.

HARDNESS: $7\frac{1}{2}$, can scratch quartz. Medium weight.

FRACTURE: uneven; brittle.

NOTE: some crystals will show red in one direction and green in another when held to a light and turned.

Andalusite

Gray.

LUSTER: nonmetallic; diamond-like sparkle when crystalline, dull when earthy; transparent to opaque.

STREAK: colorless.

HARDNESS: 3, can be scratched by a copper coin. Very heavy.

CLEAVAGE: parallel to base and side; poor.

FRACTURE: shell-like; brittle.

NOTE: may fluoresce in ultraviolet light.

Anglesite

Gray.

LUSTER: nonmetallic; glassy; pearly on cleavage surfaces; transparent to translucent.

STREAK: colorless to grayish-white.

HARDNESS: $3-3\frac{1}{2}$, can be scratched by a copper coin and cut with a knife. Medium weight.

CLEAVAGE: good in three directions, with cleavage lines meeting at right angles, yielding rectangular blocks; brittle.

Anhydrite

Gray.

LUSTER: nonmetallic; glassy; transparent to translucent to opaque.

STREAK: colorless.

HARDNESS: $3\frac{1}{2}-4$, can be scratched by a knife blade. Medium weight.

CLEAVAGE: parallel to length of crystals or columns; poor.

FRACTURE: shell-like to uneven; brittle.

NOTE: will become powdery when held in a candle flame.
May fluoresce in ultraviolet light.

Aragonite

Dark lead gray.

LUSTER: metallic; bright on fresh fracture, dull after exposure to air; opaque.

STREAK: dark gray to black, shiny.

HARDNESS: 2-2½, may possibly mark paper; can be cut easily with a knife and slightly flattened with a hammer.
Very heavy.

FRACTURE: roughly shell-like.

Argentite

Steel-gray.

LUSTER: metallic; will tarnish after exposure to air; opaque.

STREAK: grayish-black to black.

HARDNESS: 5½-6, can be scratched by a steel file; may scratch glass. Medium weight.

FRACTURE: uneven; brittle.

NOTE: garlic smell noticeable when struck with a hammer.

Arsenopyrite

Gray.

LUSTER: nonmetallic; glassy; transparent to translucent.

STREAK: colorless.

HARDNESS: 6½-7, can be scratched by quartz. Medium weight.

FRACTURE: shell-like.

NOTE: may fluoresce in ultraviolet light.

Axinite

Gray.

LUSTER: nonmetallic; glassy; pearly on cleavage surface; transparent to translucent.

STREAK: white or colorless.

HARDNESS: 3-3½, can be scratched by a knife blade, possibly by a copper coin. Heavy weight.

CLEAVAGE: perfect parallel to base; brittle.

NOTE: may fluoresce in ultraviolet light.

Barite*Gray.*

LUSTER: nonmetallic; dull, earthy; translucent to opaque.

STREAK: colorless.

HARDNESS: 1-3, can be scratched by a copper coin, possibly by the fingernail. Medium weight.

FRACTURE: earthy.

NOTE: may fluoresce in ultraviolet light.

Bauxite*Grayish.*

LUSTER: nonmetallic; glassy, pearly, dull; translucent to opaque.

STREAK: white.

HARDNESS: 2-2½, can be scratched by a copper coin. Light weight.

CLEAVAGE: parallel to front of crystals.

NOTE: soluble in water; will melt in a candle flame. May fluoresce in ultraviolet light.

Borax*Steel-gray.*

LUSTER: metallic; opaque.

STREAK: greenish-gray to yellowish-gray.

HARDNESS: 2½, can be scratched by a copper coin, possibly by the fingernail. Very heavy.

FRACTURE: uneven; very brittle.

NOTE: a small piece will melt in a candle flame.

Calaverite*Gray.*

LUSTER: nonmetallic; glassy to earthy; transparent to translucent.

STREAK: white to gray.

HARDNESS: 3, can be scratched by a copper coin. Medium weight.

CLEAVAGE: perfect in three directions at oblique angles, yielding smooth-surfaced fragments similar to figure 21.

NOTE: will frequently fluoresce in ultraviolet light.

Calcite

Gray.

LUSTER: nonmetallic; brilliant sparkle in crystals to dull in masses; translucent to opaque, rarely transparent.

STREAK: white to very pale brown.

HARDNESS: 6-7, can be scratched by quartz, possibly by a steel file. Very heavy.

FRACTURE: rough, uneven.

Cassiterite

Gray.

LUSTER: nonmetallic; diamond-like sparkle; transparent to translucent.

STREAK: white or colorless.

HARDNESS: 3-3½, can be scratched by a knife blade, possibly by a copper coin. Very heavy.

FRACTURE: shell-like; very brittle.

NOTE: a small splinter can be melted in a candle flame.

Cerussite

Gray, bands of gray and white or gray and reddish-brown.

LUSTER: nonmetallic; waxy, glassy, dull; transparent to translucent.

STREAK: colorless.

HARDNESS: 7, can be scratched by quartz. Medium weight.

FRACTURE: shell-like; brittle.

Chalcedony

Grayish, lead-gray, gray-black. May have green spots or coating.

LUSTER: metallic to dull; opaque.

STREAK: grayish-black to black.

HARDNESS: 2½-3, can be scratched by a knife blade, possibly by a copper coin; may be cut with a knife. Medium weight.

FRACTURE: granular to shell-like.

Chalcocite

Grayish-green.

LUSTER: nonmetallic; glassy; transparent to translucent.

STREAK: colorless.

HARDNESS: $8\frac{1}{2}$, easily scratches quartz. Medium weight.

CLEAVAGE: two directions, with cleavage lines meeting at right angles; brittle.

Chrysoberyl*Gray.*

LUSTER: metallic; opaque.

STREAK: grayish-black.

HARDNESS: $5\frac{1}{2}$, can be scratched by a steel file, possibly by a knife blade. Heavy weight.

CLEAVAGE: perfect in three directions, yielding small cubes; brittle.

Cobaltite*Gray.*

LUSTER: submetallic; resinous; bluish tint on fresh fracture; opaque to faintly translucent.

STREAK: dark red to brown to black.

HARDNESS: 6, can be scratched by a steel file. Heavy weight.

CLEAVAGE: good parallel to side; brittle.

Columbite*Whitish-gray.*

LUSTER: nonmetallic; glassy; transparent to translucent.

STREAK: colorless.

HARDNESS: $7-7\frac{1}{2}$, will scratch quartz. Medium weight.

FRACTURE: shell-like to uneven.

NOTE: some crystals will show various colors when held to a light and turned.

Cordierite*Gray, bluish-gray.*

LUSTER: nonmetallic; sparkling to glassy to dull; transparent to translucent to opaque.

STREAK: colorless.

HARDNESS: 9, easily scratches quartz. Heavy weight.

FRACTURE: shell-like to uneven; brittle.

NOTE: may fluoresce in ultraviolet light.

Corundum

Reddish-gray, often with green or blue spots.

LUSTER: metallic; clear crystals have diamond-like sparkle; transparent to translucent.

STREAK: brownish-red to brick-red.

HARDNESS: $3\frac{1}{2}$ –4, can be scratched by a knife blade. Medium weight.

FRACTURE: uneven; brittle.

Cuprite

Grayish-black.

LUSTER: nonmetallic; sparkling to dull; greasy; transparent to translucent; opaque in dark colors.

STREAK: colorless.

HARDNESS: 10 or over, easily scratches quartz. Medium weight.

CLEAVAGE: perfect in four directions, yielding fragments similar to figure 30; brittle.

NOTE: may fluoresce in ultraviolet light. If a crystal is rubbed, it may generate enough electricity to pick up tiny bits of paper.

Diamond

Grayish-white, gray.

LUSTER: nonmetallic; glassy to dull; translucent, occasionally transparent.

STREAK: colorless.

HARDNESS: 5–6, can be scratched by a steel file, possibly by a knife blade. Medium weight.

CLEAVAGE: fair parallel to base and side, with cleavage lines meeting at an angle of near 90° .

Diopside

Gray.

LUSTER: nonmetallic; glassy, pearly; transparent, or translucent to opaque.

GRAY

STREAK: colorless.

HARDNESS: $3\frac{1}{2}$ -4, can be scratched by a knife blade, possibly by a copper coin. Medium weight.

CLEAVAGE: good in three directions, yielding fragments similar to figure 21; brittle.

Dolomite

Lead-gray.

LUSTER: brilliant metallic; occasionally dull with tarnish; opaque.

STREAK: lead-gray to gray-black.

HARDNESS: $2\frac{1}{2}$, can be scratched by the fingernail; will mark paper. Heavy weight.

CLEAVAGE: good in three directions, yielding cubes similar to figure 31.

NOTE: a small piece held in a candle flame will slowly melt, and small drops of metallic lead will form on the surface.

Galena

Steel-gray.

LUSTER: metallic to dull earthy; opaque.

STREAK: black to grayish-black.

HARDNESS: 1-2, easily marks paper, soils fingers; can be cut with a knife. Light weight.

CLEAVAGE: perfect parallel to base, leaving small flakes that are flexible but not elastic.

NOTE: generally feels greasy.

Graphite

Gray.

LUSTER: nonmetallic; glassy, silky, or pearly; transparent to translucent to opaque.

STREAK: colorless to white.

HARDNESS: $1\frac{1}{2}$ -2, can be scratched by the fingernail. Medium weight.

CLEAVAGE: perfect parallel to side of crystal.

NOTE: may fluoresce in ultraviolet light.

Gypsum

Steel-gray.

LUSTER: brilliant metallic and translucent in crystalline variety; submetallic, dull, opaque in earthy variety.

STREAK: Indian-red to reddish-brown.

HARDNESS: 1-2½ in soft variety, can be scratched by the fingernail; 5½-6½ in harder ore, can be scratched by a steel file, possibly by a knife blade; may scratch glass. Medium weight.

FRACTURE: uneven; brittle.

NOTE: may be slightly magnetic.

Hematite

Gray. May have greenish streaks and light brown coating.

LUSTER: nonmetallic; waxy, glassy, pearly; translucent to opaque.

STREAK: colorless.

HARDNESS: 6½-7, may be scratched by quartz. Medium weight.

CLEAVAGE: fair parallel to base and side, with cleavage lines meeting at an angle of near 90°.

FRACTURE: splintery, may be hard to break.

Jadeite

Gray.

LUSTER: nonmetallic; dull earthy; pearly in plates; opaque in masses.

STREAK: white.

HARDNESS: 2-2½, can be scratched by the fingernail. Medium weight.

CLEAVAGE: parallel to base, yielding thin flexible plates.

NOTE: feels smooth, greasy; has strong clay odor when slightly damp.

Kaolinite

Gray. May have blotchy appearance.

LUSTER: nonmetallic; glassy to pearly; transparent to translucent.

STREAK: colorless to whitish.

HARDNESS: 5 parallel to length of crystal, can be scratched

GRAY

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by a knife blade; 7 across width of crystal, can be scratched by quartz. Medium weight.

CLEAVAGE: perfect parallel to length of crystals.

NOTE: crystals are generally darker in color toward the center.

Kyanite

Gray.

LUSTER: nonmetallic; pearly; translucent.

STREAK: colorless.

HARDNESS: $2\frac{1}{2}$ –4, can be scratched by a knife blade, possibly by a copper coin. Medium weight.

CLEAVAGE: perfect parallel to base.

Lepidolite

Gray.

LUSTER: nonmetallic; glassy to dull; transparent to opaque.

STREAK: white to colorless

HARDNESS: $3\frac{1}{2}$ –5, can be scratched by a knife blade. Medium weight.

CLEAVAGE: three perfect with cleavage lines meeting at oblique angles in crystalline variety.

FRACTURE: shell-like in noncrystalline variety; brittle.

Magnesite

Lead-gray with bluish tone.

LUSTER: metallic; opaque.

STREAK: dark bluish-gray to greenish-black.

HARDNESS: 1 – $1\frac{1}{2}$, can be scratched by the fingernail or shaved with a knife; will mark paper. Medium weight.

CLEAVAGE: perfect parallel to base, yielding plates that are flexible but not elastic.

NOTE: feels soapy or greasy; may fluoresce in ultraviolet light.

Molybdenite

Gray.

LUSTER: nonmetallic; glassy, pearly, silky; transparent to translucent.

STREAK: colorless.

HARDNESS: 2–2½, can be scratched by the fingernail. Medium weight.

CLEAVAGE: perfect parallel to base, yielding very thin flexible and elastic plates.

Muscovite

Gray.

LUSTER: nonmetallic; glassy; transparent to translucent.

STREAK: colorless.

HARDNESS: 5–5½, can be scratched by a knife blade. Light weight.

CLEAVAGE: perfect parallel to base and side.

Natrolite

Grayish-green.

LUSTER: nonmetallic; glassy; transparent to translucent.

STREAK: colorless.

HARDNESS: 6½–7, can be scratched by quartz. Medium weight.

FRACTURE: shell-like; brittle.

Olivine

Gray, grayish, possibly showing internal play of colors.

LUSTER: nonmetallic; glassy, waxy, pearly; transparent to translucent to opaque.

STREAK: white to colorless.

HARDNESS: 5–6½, can be scratched by a steel file, possibly by a knife blade; may scratch glass. Light weight.

FRACTURE: shell-like, leaving smooth surface.

NOTE: may fluoresce in ultraviolet light.

Opal

Gray. May show bluish-white opalescence.

LUSTER: nonmetallic; glassy, waxy; transparent to translucent.

STREAK: white.

HARDNESS: 6, can be scratched by a steel file. Medium weight.

GRAY

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CLEAVAGE: parallel to base and side, with cleavage lines meeting at a 90° angle.

Orthoclase

Light steel-gray, grayish-white. May have rust-colored coating.

LUSTER: metallic; bright; opaque.

STREAK: light gray, shiny.

HARDNESS: 4-4½, can be scratched by a knife blade, hammered into thin sheets, and drawn into a wire. Extremely heavy.

FRACTURE: rough, hackly.

NOTE: may be slightly magnetic.

Platinum

Gray.

LUSTER: nonmetallic; glassy; translucent, occasionally transparent.

STREAK: colorless.

HARDNESS: 6-6½, can be scratched by quartz, possibly by a steel file. Medium weight.

FRACTURE: rough, uneven; brittle.

Prehnite

Bluish-steel-gray.

LUSTER: metallic; opaque.

STREAK: black, sooty.

HARDNESS: 1-2½, will mark paper, soil fingers. Medium weight.

FRACTURE: splintery, uneven; brittle.

Pyrolusite

Grayish-yellow.

LUSTER: nonmetallic; glassy in crystals, greasy in rock-like masses; transparent to translucent to opaque.

STREAK: white, colorless, or very light colored.

HARDNESS: 7, can scratch glass and be scratched by quartz. Medium weight.

FRACTURE: shell-like; brittle.

NOTE: horizontal lines or grooves on crystals.

Quartz

Gray.

LUSTER: nonmetallic; glassy to pearly; transparent to translucent to opaque.

STREAK: white to colorless.

HARDNESS: $3\frac{1}{2}$ – $4\frac{1}{2}$, can be scratched by a knife blade.
Medium weight.

CLEAVAGE: perfect in three directions, with cleavage lines meeting at oblique angles.

Rhodochrosite

Gray.

LUSTER: nonmetallic; glassy to sparkling; translucent, occasionally transparent.

STREAK: colorless to white.

HARDNESS: $4\frac{1}{2}$ –5, can be scratched by a knife blade. Very heavy.

CLEAVAGE: parallel to the pyramid; good.

NOTE: highly fluorescent in ultraviolet light.

Scheelite

Gray.

LUSTER: nonmetallic; glassy to pearly; transparent to translucent.

STREAK: white to colorless.

HARDNESS: $3\frac{1}{2}$ –4, can be scratched by a knife blade. Heavy weight.

CLEAVAGE: perfect in three directions, with cleavage lines meeting at oblique angles; brittle.

NOTE: will become magnetic after being heated in a candle flame.

Siderite

Gray, grayish-brown, grayish-white.

LUSTER: nonmetallic; glassy, satiny; translucent, occasionally transparent.

STREAK: colorless.

GRAY

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HARDNESS: 6-7, can be scratched by quartz, possibly by a steel file. Medium weight.

CLEAVAGE: parallel to length of crystals or fibers.

Sillimanite

Silver-gray on fresh fracture; dark gray to grayish-black tarnish.

LUSTER: metallic; opaque.

STREAK: silver-white.

HARDNESS: 2½-3, can be scratched by a knife blade, hammered into thin sheets, and drawn into a wire. Very heavy.

FRACTURE: jagged, hackly.

Silver

Grayish.

LUSTER: nonmetallic; glassy; translucent to opaque.

STREAK: colorless to whitish.

HARDNESS: 5, can be scratched by a knife blade. Heavy weight.

CLEAVAGE: good in three directions, yielding fragments similar to figure 21; cleavage lines not always distinct; brittle.

Smithsonite

Gray.

LUSTER: nonmetallic; resinous to sparkling; transparent to translucent to opaque.

STREAK: colorless, white, possible slight reddish tint.

HARDNESS: 5-5½, can be scratched by a steel file, possibly by a knife blade. Medium weight.

CLEAVAGE: two directions, parallel to base and side.

Sphene

Gray, grayish-white.

LUSTER: nonmetallic; glassy to pearly on cleavage surface; transparent to translucent.

STREAK: colorless to white.

HARDNESS: 6½-7, can be scratched by quartz. Medium weight.

CLEAVAGE: perfect parallel to base and side, with cleavage lines meeting at an angle of near 90° ; brittle.

NOTE: a crystal may show different colors when held to a light and turned. May fluoresce in ultraviolet light.

Spodumene

Lead-gray.

LUSTER: metallic; brilliant on cleavage surface; opaque.

STREAK: lead-gray to black.

HARDNESS: 2, can be scratched by the fingernail; will mark paper. Medium weight.

CLEAVAGE: perfect along length, leaving polished-looking surface.

NOTE: a small piece will melt in a candle flame.

Stibnite

Grayish-yellow.

LUSTER: nonmetallic; resinous; transparent to translucent.

STREAK: pale yellow to white.

HARDNESS: $1\frac{1}{2}$ – $2\frac{1}{2}$, can be scratched by the fingernail and easily cut with a knife. Light weight.

FRACTURE: shell-like to uneven; brittle.

NOTE: if a crystal is rubbed, it may generate enough electricity to pick up tiny bits of paper.

Sulphur

Steel-gray.

LUSTER: metallic; brilliant; opaque.

STREAK: gray to grayish-black.

HARDNESS: $1\frac{1}{2}$ –2, can be scratched by the fingernail. Heavy weight.

CLEAVAGE: parallel to side of crystal.

NOTE: a small piece will melt in a candle flame.

Sylvanite

Light to dark gray.

LUSTER: nonmetallic; pearly, possibly greasy; translucent.

STREAK: white.

HARDNESS: 1 – $1\frac{1}{2}$, can be scratched by the fingernail and easily carved with a knife. Medium weight.

CLEAVAGE: parallel to base, yielding scales or plates that are flexible but not elastic.

NOTE: may feel soapy or slippery.

Talc

Dark gray, grayish-black.

LUSTER: metallic, often brilliant; opaque.

STREAK: black to brown to reddish.

HARDNESS: 3–4½, can be scratched by a knife blade, possibly by a copper coin. Medium weight.

FRACTURE: uneven; brittle.

Tetrahedrite

Grayish. May have orange-yellow or brownish-yellow streaks.

LUSTER: nonmetallic; glassy, resinous, greasy; transparent to translucent to opaque.

STREAK: brown to black in thorite, orange-yellow in orangeite.

HARDNESS: 4½–5, can be scratched by a knife blade. Heavy weight.

FRACTURE: shell-like.

NOTE: radioactive.

Thorite

Gray.

LUSTER: nonmetallic; silky in fibrous variety; glassy; pearly on cleavage surface; transparent to translucent.

STREAK: colorless to whitish or grayish.

HARDNESS: 5–6, can be scratched by a steel file, possibly by a knife blade. Medium weight.

CLEAVAGE: in two directions, with cleavage lines at angles of 56° and 124°; often splintery.

Tremolite

Grayish-black. May have spots of greenish or yellowish coating.

LUSTER: submetallic; pitchy, dull; opaque.

STREAK: brownish-black, possibly grayish-black or greenish-black.

HARDNESS: $5\frac{1}{2}$, can be scratched by a steel file, possibly by a knife blade. Very heavy.

FRACTURE: shell-like to uneven; brittle.

NOTE: strongly-radioactive.

Uraninite—Pitchblende

Grayish-black.

LUSTER: metallic to submetallic; often resinous; opaque.

STREAK: brown to black.

HARDNESS: $5-5\frac{1}{2}$, can be scratched by a steel file, possibly by a knife blade. Very heavy.

CLEAVAGE: perfect parallel to side; brittle.

NOTE: bright red in thin splinters.

Wolframite

Gray.

LUSTER: nonmetallic; glassy; silky when fibrous; pearly on cleavage surface; faintly transparent to translucent.

STREAK: colorless to whitish to grayish.

HARDNESS: $4\frac{1}{2}-5$, can be scratched by a knife blade. Medium weight.

CLEAVAGE: parallel to front and base; brittle.

NOTE: may fluoresce in ultraviolet light.

Wollastonite

Grayish.

LUSTER: nonmetallic; diamond-like sparkle; translucent to opaque; occasionally transparent.

STREAK: colorless.

HARDNESS: $7\frac{1}{2}$, will scratch quartz. Heavy weight.

FRACTURE: shell-like; brittle.

Zircon

Gray, grayish-white.

LUSTER: nonmetallic; glassy, pearly on cleavage surface; transparent to translucent.

STREAK: colorless.

HARDNESS: $6-6\frac{1}{2}$, can be scratched by quartz, possibly by a steel file. Medium weight.

GREEN

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CLEAVAGE: parallel to length; brittle.

NOTE: may fluoresce in ultraviolet light.

Zoisite

GREEN

Very light to dark green, sometimes with tan coating.

LUSTER: nonmetallic; glassy, pearly or silky; translucent, occasionally transparent.

STREAK: colorless.

HARDNESS: 5-6, can be scratched by a steel file, possibly by a knife blade. Medium weight.

CLEAVAGE: perfect in two directions, with cleavage lines meeting at angles of 56° and 124° .

NOTE: may be very tough and fibrous.

Actinolite

Greenish.

LUSTER: nonmetallic; glassy to pearly; transparent to translucent.

STREAK: colorless.

HARDNESS: 6-6½, can be scratched by quartz, possibly by a steel file. Medium weight.

CLEAVAGE: in two directions, with cleavage lines meeting at an angle of near 90° ; brittle.

NOTE: may fluoresce in ultraviolet light.

Albite

Pale green, gray-green.

LUSTER: nonmetallic; glassy; pearly on cleavage surface; translucent to transparent.

STREAK: white.

HARDNESS: 6, can be scratched by a steel file. Medium weight.

CLEAVAGE: perfect parallel to base; brittle.

Amblygonite

Greenish.

LUSTER: nonmetallic; glassy; transparent to translucent.

STREAK: colorless.

HARDNESS: 5-5½, can be scratched by a steel file, possibly by a knife blade. Medium weight.

FRACTURE: usually even; brittle.

NOTE: when rubbed or slightly heated, the crystals may generate enough electricity to pick up tiny bits of paper.

Analcite

Olive green.

LUSTER: nonmetallic; glassy; translucent to opaque, occasionally transparent.

STREAK: colorless.

HARDNESS: $7\frac{1}{2}$, will scratch quartz. Medium weight.

FRACTURE: uneven; brittle.

NOTE: some crystals will show red in one direction and green in another when held to a light and turned.

Andalusite

Greenish.

LUSTER: nonmetallic; diamond-like sparkle when crystalline, dull when earthy; transparent to opaque.

STREAK: colorless.

HARDNESS: 3, can be scratched by a copper coin. Very heavy.

CLEAVAGE: parallel to base and side; poor.

FRACTURE: shell-like; brittle.

NOTE: may fluoresce in ultraviolet light.

Anglesite

Green; frequently has patchy or melted appearance.

LUSTER: nonmetallic; glassy, resinous, greasy; transparent to translucent to opaque.

STREAK: colorless to white.

HARDNESS: 5, can be scratched easily by a steel file, possibly by a knife blade. Medium weight.

CLEAVAGE: parallel to base and side; poor.

FRACTURE: shell-like; brittle.

NOTE: may fluoresce in ultraviolet light.

Apatite

Green.

LUSTER: nonmetallic; glassy; transparent to translucent to opaque.

GREEN

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STREAK: colorless.

HARDNESS: 3½-4, can be scratched by a knife blade. Medium weight.

CLEAVAGE: parallel to length of crystals or columns; poor.

FRACTURE: shell-like to uneven; brittle.

NOTE: will become powdery when held in a candle flame.

May fluoresce in ultraviolet light.

Aragonite

Dark green.

LUSTER: nonmetallic; glassy; translucent on thin edges.

STREAK: colorless.

HARDNESS: 5-6, can be scratched by a steel file, possibly by a knife blade. Medium weight.

CLEAVAGE: in two directions, with cleavage lines meeting at an angle of near 90°.

Augite

Apple green.

LUSTER: nonmetallic; glassy, pearly, satiny; translucent.

STREAK: yellowish, possibly greenish.

HARDNESS: 2-2½, can be scratched by a copper coin, possibly by the fingernail. Medium weight.

CLEAVAGE: parallel to base; brittle.

NOTE: radioactive; highly fluorescent in ultraviolet light.

Autunite

Greenish.

LUSTER: nonmetallic; glassy; transparent to translucent.

STREAK: colorless.

HARDNESS: 6½-7, can be scratched by quartz. Medium weight.

FRACTURE: shell-like.

NOTE: may fluoresce in ultraviolet light.

Axinite

Green, blue-green.

LUSTER: nonmetallic; glassy; transparent to translucent.

STREAK: colorless.

HARDNESS: 6–6½, can be scratched by quartz. Medium weight.

FRACTURE: shell-like.

NOTE: may fluoresce in ultraviolet light.

Benitoite

Emerald or deep green, blue-green. May have frosted or mottled appearance.

LUSTER: nonmetallic; glassy; transparent to translucent, occasionally opaque.

STREAK: white or colorless.

HARDNESS: 7½–8, will scratch quartz. Medium weight.

CLEAVAGE: parallel to base; poor.

FRACTURE: shell-like to uneven; brittle.

Beryl

Dark green.

LUSTER: nonmetallic; glassy, shining; pearly on cleavage surfaces; transparent in very thin plates, and translucent, possibly opaque, in thicker plates.

STREAK: colorless.

HARDNESS: 2½–3, can be scratched by a copper coin, possibly by the fingernail. Medium weight.

CLEAVAGE: perfect parallel to base, separating easily into very thin elastic plates of light gray color.

Biotite

Green.

LUSTER: nonmetallic; glassy to earthy; transparent to translucent.

STREAK: white to gray.

HARDNESS: 3, can be scratched by a copper coin. Medium weight.

CLEAVAGE: perfect in three directions at oblique angles, yielding smooth-surfaced fragments similar to figure 21.

NOTE: will frequently fluoresce in ultraviolet light.

Calcite

Greenish-yellow.

LUSTER: nonmetallic; dull, earthy, pearly; opaque.

GREEN

STREAK: pale yellow.

HARDNESS: 2-3, can be scratched by the fingernail. Heavy weight.

FRACTURE: granular, earthy.

NOTE: strongly radioactive; may fluoresce in ultraviolet light.

Carnotite

Dark dull green, apple green, yellowish-green, dark green with reddish-brown spots.

LUSTER: nonmetallic; waxy, glassy, dull; transparent to translucent to opaque.

STREAK: colorless.

HARDNESS: 7, can be scratched by quartz. Medium weight.

FRACTURE: shell-like; brittle.

Chalcedony

Green.

LUSTER: nonmetallic; glassy to pearly; translucent to opaque; occasionally transparent.

STREAK: colorless to white to pale green.

HARDNESS: 2-2½, can be scratched by the fingernail. Medium weight.

CLEAVAGE: perfect parallel to base, yielding plates that are flexible but not elastic.

Chlorite

Emerald-green, brownish-green, grayish-green, yellowish-green.

LUSTER: nonmetallic; glassy; transparent to translucent.

STREAK: colorless.

HARDNESS: 8½, easily scratches quartz. Medium weight.

CLEAVAGE: two directions, with cleavage lines meeting at right angles; brittle.

Chrysoberyl

Green, greenish-blue. May have black streaks.

LUSTER: nonmetallic; glassy to earthy; translucent to opaque.

STREAK: light blue to almost white.

HARDNESS: 2-4, can be scratched by a knife blade, possibly by a copper coin. Light weight.

FRACTURE: shell-like.

NOTE: if touched to the tongue, will often stick to it.

Chrysocolla

Green.

LUSTER: nonmetallic; sparkling to glassy to dull; transparent to translucent to opaque.

STREAK: colorless.

HARDNESS: 9, easily scratches quartz. Heavy weight.

FRACTURE: shell-like to uneven; brittle.

NOTE: may fluoresce in ultraviolet light.

Corundum

Pale green.

LUSTER: nonmetallic; sparkling to dull; greasy; transparent to translucent; opaque in dark colors.

STREAK: colorless.

HARDNESS: 10 or over, easily scratches quartz. Medium weight.

CLEAVAGE: perfect in four directions, yielding fragments similar to figure 30; brittle.

NOTE: may fluoresce in ultraviolet light. If a crystal is rubbed, it may generate enough electricity to pick up tiny bits of paper.

Diamond

Green

LUSTER: nonmetallic; glassy to dull; translucent, occasionally transparent.

STREAK: colorless.

HARDNESS: 5-6, can be scratched by a steel file, possibly by a knife blade. Medium weight.

CLEAVAGE: fair parallel to base and side, with cleavage lines meeting at an angle of near 90°.

Diopside

Green.

LUSTER: nonmetallic; glassy, pearly; transparent, or translucent to opaque.

STREAK: colorless.

GREEN

THE ROCK-HUNTER'S FIELD MANUAL

HARDNESS: $3\frac{1}{2}$ –4, can be scratched by a knife blade, possibly by a copper coin. Medium weight.

CLEAVAGE: good in three directions, yielding fragments similar to figure 21; brittle.

Dolomite

Greenish-blue; a very distinctive color.

LUSTER: nonmetallic; glassy; transparent to translucent.

STREAK: colorless.

HARDNESS: 7, can be scratched by quartz. Medium weight.

CLEAVAGE: parallel to length of fibers; poor.

Dumortierite

Green, blackish-green, yellowish-green, brownish-green, pistachio.

LUSTER: nonmetallic; glassy; pearly on cleavage surface; transparent to opaque.

STREAK: colorless to grayish-white.

HARDNESS: 6–7, can be scratched by quartz, possibly by a steel file. Medium weight.

CLEAVAGE: good parallel to length of crystals; brittle.

NOTE: a crystal will show green in one direction and brown in another when held to a light and turned.

Epidote

Green, bluish-green.

LUSTER: nonmetallic; glassy; transparent to translucent.

STREAK: colorless to white.

HARDNESS: 4, can be scratched by a knife blade. Medium weight.

CLEAVAGE: perfect in four directions, yielding fragments similar to figure 30.

NOTE: will generally fluoresce in ultraviolet light.

Fluorite

Green, dark green, emerald green.

LUSTER: nonmetallic; glassy to resinous; transparent to translucent, occasionally opaque.

STREAK: colorless to white.

HARDNESS: $6\frac{1}{2}$ – $7\frac{1}{2}$, can be scratched by quartz at 7 and under; over 7 will scratch quartz. Heavy weight.

FRACTURE: uneven.

Garnet

Apple-green, greenish-white.

LUSTER: metallic; dull, earthy.

STREAK: colorless.

HARDNESS: 2–3, can be scratched by the fingernail. Medium weight.

FRACTURE: uneven; crumbly.

Garnierite

Greenish.

LUSTER: nonmetallic; sparkling, glassy, pearly; transparent to translucent.

STREAK: white.

HARDNESS: $4\frac{1}{2}$ –5, can be scratched by a knife blade. Medium weight.

CLEAVAGE: parallel to base and side; brittle.

NOTE: will frequently fluoresce in ultraviolet light.

Hemimorphite

Dark green.

LUSTER: nonmetallic; glassy; silky when fibrous; pearly on cleavage surfaces; translucent on thin edges.

STREAK: colorless to grayish.

HARDNESS: 5–6, can be scratched by a steel file, possibly by a knife blade. Medium weight.

CLEAVAGE: perfect in two directions, with cleavage lines meeting at angles of 56° and 124° .

Hornblende

Green, yellowish-green, sometimes with white or grayish streaks.

LUSTER: nonmetallic; glassy to resinous; subtranslucent to translucent, occasionally transparent.

STREAK: white.

HARDNESS: $6\frac{1}{2}$, can be scratched by quartz, possibly by a steel file. Medium weight.

GREEN

THE ROCK-HUNTER'S FIELD MANUAL

FRACTURE: roughly shell-like; brittle.

Idocrase

Green of various shades, usually apple or emerald. May have light brown coating.

LUSTER: nonmetallic; waxy, glassy, pearly; translucent to opaque.

STREAK: colorless.

HARDNESS: 6½–7, may be scratched by quartz. Medium weight.

CLEAVAGE: fair parallel to base and side, with cleavage lines meeting at an angle of near 90°.

FRACTURE: splintery, may be hard to break.

Jadeite

Green. May have blotchy appearance.

LUSTER: nonmetallic; glassy to pearly; transparent to translucent.

STREAK: colorless to whitish.

HARDNESS: 5, parallel to length of crystal, can be scratched by a knife blade; 7 across width of crystal, can be scratched by quartz. Medium weight.

CLEAVAGE: perfect parallel to length of crystals.

NOTE: crystals are generally darker in color toward the center.

Kyanite

Greenish-blue.

LUSTER: nonmetallic; glassy; translucent.

STREAK: colorless.

HARDNESS: 5–5½, can be scratched by a knife blade. Medium weight.

FRACTURE: uneven.

Lazurite

Bright green. Often shows rows of different shades of green.

LUSTER: nonmetallic; sparkling to glassy in crystals, silky when fibrous, dull when earthy; translucent to opaque.

STREAK: pale green.

COLOR KEY**GREEN**

HARDNESS: 3½–4, can be scratched by a knife blade. Heavy weight.

CLEAVAGE: parallel to base; difficult to see in fibrous variety.

FRACTURE: uneven, splintery; brittle.

Malachite*Green.*

LUSTER: nonmetallic; glassy; occasionally pearly; transparent to translucent.

STREAK: colorless.

HARDNESS: 6, can be scratched by a steel file. Medium weight.

CLEAVAGE: parallel to base and side; brittle.

NOTE: may fluoresce in ultraviolet light.

Microcline*Pale green.*

LUSTER: nonmetallic; glassy, pearly, silky; transparent to translucent.

STREAK: colorless.

HARDNESS: 2–2½, can be scratched by the fingernail. Medium weight.

CLEAVAGE: perfect parallel to base, yielding very thin flexible and elastic plates.

Muscovite*Green, olive-green, yellow-green, bottle-green, grayish-green.*

LUSTER: nonmetallic; glassy; transparent to translucent.

STREAK: colorless.

HARDNESS: 6½–7, can be scratched by quartz. Medium weight.

FRACTURE: shell-like; brittle.

Olivine*Green.*

LUSTER: nonmetallic; glassy, waxy, pearly; transparent to translucent to opaque.

STREAK: white to colorless.

HARDNESS: 5–6½, can be scratched by a steel file, possibly by a knife blade; may scratch glass. Light weight.

GREEN

THE ROCK-HUNTER'S FIELD MANUAL

FRACTURE: shell-like, leaving smooth surface.

NOTE: may fluoresce in ultraviolet light.

Opal

Light-green, yellowish-green.

LUSTER: nonmetallic; glassy; translucent, occasionally transparent.

STREAK: colorless.

HARDNESS: 6–6½, can be scratched by quartz, possibly by a steel file. Medium weight.

FRACTURE: rough, uneven; brittle.

Prehnite

Green.

LUSTER: nonmetallic; glassy to sparkling; translucent, occasionally transparent.

STREAK: colorless to white.

HARDNESS: 4½–5, can be scratched by a knife blade. Very heavy.

CLEAVAGE: parallel to the pyramid; good.

NOTE: highly fluorescent in ultraviolet light.

Scheelite

Blackish-green, yellowish-green, brownish-green. Often has a mottled appearance.

LUSTER: nonmetallic; greasy, waxy; silky in fibrous variety; translucent to opaque.

STREAK: white or colorless, possible glassy appearance.

HARDNESS: 2½–4 (5), can be scratched by a copper coin in soft varieties, or by a knife blade. Medium weight.

FRACTURE: splintery to shell-like.

NOTE: feels smooth, sometimes soapy.

Serpentine

Pale to olive green, pale bluish-green.

LUSTER: nonmetallic; glassy, satiny; translucent, occasionally transparent.

STREAK: colorless.

HARDNESS: 6–7, can be scratched by quartz, possibly by a steel file. Medium weight.

CLEAVAGE: parallel to length of crystals or fibers.

Sillimanite

Green, greenish, bluish-green.

LUSTER: nonmetallic; glassy; translucent to opaque.

STREAK: colorless to whitish.

HARDNESS: 5, can be scratched by a knife blade. Heavy weight.

CLEAVAGE: good in three directions, yielding fragments similar to figure 21; cleavage lines not always distinct; brittle.

Smithsonite

Green.

LUSTER: nonmetallic; resinous to sparkling; transparent to translucent to opaque.

STREAK: brown to yellowish to whitish.

HARDNESS: 3½–4, can be scratched by a knife blade. Heavy weight.

CLEAVAGE: perfect in six directions, yielding fragments similar to figure 28.

NOTE: may fluoresce in ultraviolet light.

Sphalerite

Green, greenish-yellow, chartreuse.

LUSTER: nonmetallic; resinous to sparkling; transparent to translucent to opaque.

STREAK: colorless, white, possible slight reddish tint.

HARDNESS: 5–5½, can be scratched by a steel file, possibly by a knife blade. Medium weight.

CLEAVAGE: two directions, parallel to base and side.

Sphene

Green, greenish-brown, dark green.

LUSTER: nonmetallic; glassy, sparkling; transparent to translucent, may be opaque in dark colors.

STREAK: white.

HARDNESS: 8, will scratch quartz. Medium weight.

FRACTURE: shell-like; brittle.

Spinel

Emerald-green, greenish-white, yellowish-green.

LUSTER: nonmetallic; glassy to pearly on cleavage surface; transparent to translucent.

STREAK: colorless to white.

HARDNESS: $6\frac{1}{2}$ -7, can be scratched by quartz. Medium weight.

CLEAVAGE: perfect parallel to base and side, with cleavage lines meeting at an angle of near 90° ; brittle.

NOTE: a crystal may show different colors when held to a light and turned. May fluoresce in ultraviolet light.

Spodumene

Greenish-yellow.

LUSTER: nonmetallic; resinous; transparent to translucent.

STREAK: pale yellow to white.

HARDNESS: $1\frac{1}{2}$ - $2\frac{1}{2}$, can be scratched by the fingernail and easily cut with a knife. Light weight.

FRACTURE: shell-like to uneven; brittle.

NOTE: if a crystal is rubbed, it may generate enough electricity to pick up tiny bits of paper.

Sulphur

Apple green, light to dark green.

LUSTER: nonmetallic; pearly, possibly greasy; translucent.

STREAK: white.

HARDNESS: 1 - $1\frac{1}{2}$, can be scratched by the fingernail and easily carved with a knife. Medium weight.

CLEAVAGE: parallel to base, yielding scales or plates that are flexible but not elastic.

NOTE: may feel soapy or slippery.

Talc

Green. May have orange-yellow or brownish-yellow streaks.

LUSTER: nonmetallic; glassy, resinous, greasy; transparent to translucent to opaque.

STREAK: brown to black in thornite, orange-yellow in orange-ite.

HARDNESS: $4\frac{1}{2}$ -5, can be scratched by a knife blade. Heavy weight.

FRACTURE: shell-like.

NOTE: radioactive.

Thorite

Greenish.

LUSTER: nonmetallic; glassy; transparent, occasionally translucent.

STREAK: colorless.

HARDNESS: 8, will scratch quartz. Medium weight.

CLEAVAGE: perfect parallel to base; brittle.

NOTE: if a crystal is rubbed, it will generate enough electricity to pick up tiny bits of paper. May fluoresce in ultraviolet light.

Topaz

Emerald-green, grass-green, apple-green, yellow-green.

LUSTER: nonmetallic; glassy, pearly; transparent to translucent.

STREAK: paler green than color of mineral.

HARDNESS: 2-2½, can be scratched by a copper coin, possibly by the fingernail. Medium weight.

CLEAVAGE: parallel to base, separating into thin sheets.

NOTE: radioactive; may fluoresce in ultraviolet light.

Torbernite

Green.

LUSTER: nonmetallic; glassy to resinous; transparent to translucent to opaque.

STREAK: colorless.

HARDNESS: 7-7½, will scratch quartz. Medium weight.

FRACTURE: shell-like to uneven; brittle.

NOTE: a crystal will show different colors when held to a light and turned. May fluoresce in ultraviolet light.

Tourmaline

Green, apple-green, bluish-green.

LUSTER: nonmetallic; waxy, dull; faintly translucent to opaque.

STREAK: colorless, whitish, greenish.

GREEN

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HARDNESS: 6, can be scratched by quartz, possibly by a steel file; may scratch glass. Medium weight.

FRACTURE: shell-like, smooth.

Turquoise

Greenish-black. May have spots of yellowish coating.

LUSTER: submetallic; pitchy, dull; opaque.

STREAK: brownish-black, possibly grayish-black or greenish-black.

HARDNESS: 5½, can be scratched by a steel file, possibly by a knife blade. Very heavy

FRACTURE: shell-like to uneven; brittle.

NOTE: strongly radioactive.

Uraninite-Pitchblende

Green, apple-green, yellow-green.

LUSTER: nonmetallic; glassy to resinous; transparent to translucent.

STREAK: colorless.

HARDNESS: 5½, can be scratched by a steel file, possibly by a knife blade. Heavy weight.

FRACTURE: shell-like to uneven; brittle.

NOTE: may show flashes of light when struck with a hammer or scratched with a sharp instrument. Highly fluorescent in ultraviolet light.

Willemite

Greenish.

LUSTER: nonmetallic; diamond-like sparkle; translucent to opaque, occasionally transparent.

STREAK: colorless.

HARDNESS: 7½, will scratch quartz. Heavy weight.

FRACTURE: shell-like; brittle.

Zircon

Greenish.

LUSTER: nonmetallic; glassy, pearly on cleavage surface; transparent to translucent.

STREAK: colorless.

COLOR KEY

PURPLE

HARDNESS: 6-6½, can be scratched by quartz, possibly by a steel file. Medium weight.

CLEAVAGE: parallel to length; brittle.

NOTE: may fluoresce in ultraviolet light.

Zoisite

PURPLE

Violet. Frequently has patchy or melted appearance.

LUSTER: nonmetallic; glassy, resinous, greasy; transparent to translucent to opaque.

STREAK: colorless to white.

HARDNESS: 5, can be scratched easily by a steel file, possibly by a knife blade. Medium weight.

CLEAVAGE: parallel to base and side; poor.

FRACTURE: shell-like; brittle.

NOTE: may fluoresce in ultraviolet light.

Apatite

Violet.

LUSTER: nonmetallic; glassy; transparent to translucent to opaque.

STREAK: colorless.

HARDNESS: 3½-4, can be scratched by a knife blade. Medium weight.

CLEAVAGE: parallel to length of crystals or columns; poor.

FRACTURE: shell-like to uneven; brittle.

NOTE: will become powdery when held in a candle flame.

May fluoresce in ultraviolet light.

Aragonite

Lavender, purple, violet.

LUSTER: nonmetallic; glassy; transparent to translucent.

STREAK: colorless.

HARDNESS: 6½-7, can be scratched by quartz. Medium weight.

FRACTURE: shell-like.

NOTE: may fluoresce in ultraviolet light.

Axinite

PURPLE

THE ROCK-HUNTER'S FIELD MANUAL

Purple tarnish over brownish-bronze, or reddish-brown.

LUSTER: metallic; opaque.

STREAK: gray-black to black.

HARDNESS: 3, can be scratched by a knife blade, possibly by a copper coin. Medium weight.

FRACTURE: uneven; brittle.

Bornite

Violet.

LUSTER: nonmetallic; glassy to pearly; translucent to opaque, occasionally transparent.

STREAK: colorless to white to pale green.

HARDNESS: 2-2½, can be scratched by the fingernail. Medium weight.

CLEAVAGE: perfect parallel to base, yielding plates that are flexible but not elastic.

Chlorite

Purple.

LUSTER: nonmetallic; glassy; transparent to translucent.

STREAK: colorless.

HARDNESS: 7-7½, will scratch quartz. Medium weight.

FRACTURE: shell-like to uneven.

NOTE: some crystals will show various colors when held to a light and turned.

Cordierite

Purple.

LUSTER: nonmetallic; sparkling to glassy to dull; transparent to translucent to opaque.

STREAK: colorless.

HARDNESS: 9, easily scratches quartz. Heavy weight.

FRACTURE: shell-like to uneven; brittle.

NOTE: may fluoresce in ultraviolet light.

Corundum

Purple.

LUSTER: nonmetallic; glassy to dull; translucent, occasionally transparent.

STREAK: colorless.

HARDNESS: 5–6, can be scratched by a steel file, possibly by a knife blade. Medium weight.

CLEAVAGE: fair parallel to base and side, with cleavage lines meeting at an angle of near 90°.

Diopside

Violet.

LUSTER: nonmetallic; glassy; transparent to translucent.

STREAK: colorless.

HARDNESS: 7, can be scratched by quartz. Medium weight.

CLEAVAGE: parallel to length of fibers; poor

Dumortierite

Purple.

LUSTER: nonmetallic; glassy; transparent to translucent.

STREAK: colorless or white.

HARDNESS: 4, can be scratched by a knife blade. Medium weight.

CLEAVAGE: perfect in four directions, yielding fragments similar to figure 30.

NOTE: will generally fluoresce in ultraviolet light

Fluorite

Purple.

LUSTER: nonmetallic; glassy; transparent to translucent.

STREAK: colorless.

HARDNESS: 2½, can be scratched by a copper coin, possibly by the fingernail. Light weight.

CLEAVAGE: perfect in three directions, yielding small square cubes; somewhat brittle.

NOTE: soluble in water; a small piece will melt in a candle flame. May fluoresce in ultraviolet light.

Halite

Violet-blue.

LUSTER: nonmetallic; glassy; translucent.

STREAK: colorless.

HARDNESS: 5–5½, can be scratched by a knife blade. Medium weight.

PURPLE

FRACTURE: uneven.

Lazurite

Lavender, violet.

LUSTER: nonmetallic; pearly; translucent.

STREAK: colorless.

HARDNESS: $2\frac{1}{2}$ –4, can be scratched by a knife blade, possibly by a copper coin. Medium weight.

CLEAVAGE: perfect parallel to base

Lepidolite

Purple, violet.

LUSTER: nonmetallic; glassy in crystals, greasy in rock-like masses; transparent to translucent to opaque

STREAK: white, colorless, or very light colored.

HARDNESS: 7, can scratch glass and be scratched by quartz. Medium weight.

FRACTURE: shell-like; brittle.

NOTE: horizontal lines or grooves on crystals. May fluoresce in ultraviolet light.

Quartz

Violet, purple.

LUSTER: nonmetallic; glassy, sparkling; transparent to translucent, may be opaque in dark colors.

STREAK: white.

HARDNESS: 8, will scratch quartz. Medium weight.

FRACTURE: shell-like; brittle.

Spinel

Lavender.

LUSTER: nonmetallic; glassy to pearly on cleavage surface; transparent to translucent.

STREAK: colorless to white.

HARDNESS: $6\frac{1}{2}$ –7, can be scratched by quartz. Medium weight.

CLEAVAGE: perfect parallel to base and side, with cleavage lines meeting at an angle of near 90° ; brittle.

NOTE: a crystal may show different colors when held to a light and turned. May fluoresce in ultraviolet light.

Spodumene

RED

Reddish.

LUSTER: nonmetallic; glassy to pearly; transparent to translucent.

STREAK: colorless.

HARDNESS: 6–6½, can be scratched by quartz, possibly by a steel file. Medium weight.

CLEAVAGE: in two directions, with cleavage lines meeting at an angle of near 90°; brittle.

NOTE: may fluoresce in ultraviolet light.

Albite*Reddish.*

LUSTER: nonmetallic; glassy; transparent to translucent.

STREAK: colorless.

HARDNESS: 5–5½, can be scratched by a steel file, possibly by a knife blade. Medium weight.

FRACTURE: usually even; brittle.

NOTE: when rubbed or slightly heated, the crystals may generate enough electricity to pick up tiny bits of paper.

Analcite*Pink, rose-red, reddish-brown.*

LUSTER: nonmetallic; glassy; translucent to opaque, occasionally transparent.

STREAK: colorless.

HARDNESS: 7½, will scratch quartz. Medium weight.

FRACTURE: uneven; brittle.

NOTE: some crystals will show red in one direction and green in another when held to a light and turned.

Andalusite*Pale red.*

LUSTER: nonmetallic; glassy; pearly on cleavage surfaces; transparent to translucent.

RED

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STREAK: colorless to grayish-white.

HARDNESS: 3-3½, can be scratched by a copper coin and cut with a knife. Medium weight.

CLEAVAGE: good in three directions, with cleavage lines meeting at right angles, yielding rectangular blocks; brittle.

Anhydrite

Pink; frequently has patchy or melted appearance.

LUSTER: nonmetallic; glassy, resinous, greasy; transparent to translucent to opaque.

STREAK: colorless to white.

HARDNESS: 5, can be scratched easily by a steel file, possibly by a knife blade. Medium weight.

CLEAVAGE: parallel to base and side; poor.

FRACTURE: shell-like; brittle.

NOTE: may fluoresce in ultraviolet light

Apatite

Pink.

LUSTER: nonmetallic; glassy; transparent to translucent.

STREAK: colorless.

HARDNESS: 6½-7, can be scratched by quartz. Medium weight.

FRACTURE: shell-like.

NOTE: may fluoresce in ultraviolet light.

Axinite

Red.

LUSTER: nonmetallic; glassy; pearly on cleavage surface; transparent to translucent.

STREAK: white or colorless.

HARDNESS: 3-3½, can be scratched by a knife blade, possibly by a copper coin. Heavy weight.

CLEAVAGE: perfect parallel to base; brittle.

NOTE: may fluoresce in ultraviolet light.

Barite

Reddish.

LUSTER: nonmetallic; dull, earthy; translucent to opaque.

STREAK: colorless.

HARDNESS: 1-3, can be scratched by a copper coin, possibly by the fingernail. Medium weight.

FRACTURE: earthy.

NOTE: may fluoresce in ultraviolet light.

Bauxite

Pink, deep rose-red. May have frosted or mottled appearance.

LUSTER: nonmetallic; glassy; transparent to translucent, occasionally opaque.

STREAK: white or colorless.

HARDNESS: 7½-8, will scratch quartz. Medium weight.

CLEAVAGE: parallel to base; poor.

FRACTURE: shell-like to uneven; brittle.

Beryl

Reddish-brown on fresh fracture; purple tarnish on exposure to air.

LUSTER: metallic; opaque.

STREAK: gray-black to black.

HARDNESS: 3, can be scratched by a knife blade, possibly by a copper coin. Medium weight.

FRACTURE: uneven; brittle.

Bornite

Red.

LUSTER: nonmetallic; glassy to earthy; transparent to translucent.

STREAK: white to gray.

HARDNESS: 3, can be scratched by a copper coin. Medium weight.

CLEAVAGE: perfect in three directions at oblique angles, yielding smooth-surfaced fragments similar to figure 21.

NOTE: will frequently fluoresce in ultraviolet light.

Calcite

Reddish.

LUSTER: nonmetallic; brilliant sparkle in crystals to dull in masses; translucent to opaque, rarely transparent.

RED

THE ROCK-HUNTER'S FIELD MANUAL

STREAK: white to very pale brown.

HARDNESS: 6-7, can be scratched by quartz, possibly by a steel file. Very heavy

FRACTURE: rough, uneven.

Cassiterite

Light red.

LUSTER: nonmetallic; glassy to pearly; transparent to translucent to opaque.

STREAK: colorless to white.

HARDNESS: 3-3½, can be scratched by a knife blade, possibly by a copper coin. Heavy weight.

CLEAVAGE: perfect parallel to base.

NOTE: may fluoresce in ultraviolet light.

Celestite

Dark-red, clear deep red, flesh-red, orange-red, reddish-brown, reddish-white; bands of black and reddish-brown.

LUSTER: nonmetallic; waxy, glassy, dull; transparent to translucent.

STREAK: colorless.

HARDNESS: 7, can be scratched by quartz. Medium weight.

FRACTURE: shell-like; brittle.

Chalcedony

Rose-red.

LUSTER: nonmetallic; glassy to pearly; translucent to opaque, occasionally transparent.

STREAK: colorless to white to pale green.

HARDNESS: 2-2½, can be scratched by the fingernail. Medium weight.

CLEAVAGE: perfect parallel to base, yielding plates that are flexible but not elastic.

Chlorite

Bright red, dark red, scarlet, reddish-brown.

LUSTER: nonmetallic; diamond-like sparkle to dull; transparent to translucent.

STREAK: scarlet to dark red.

HARDNESS: 2–2½, can be scratched by the fingernail. Heavy weight.

CLEAVAGE: perfect in two directions, with cleavage lines meeting at right angles.

Cinnabar

White with reddish tint.

LUSTER: metallic; opaque.

STREAK: grayish-black.

HARDNESS: 5½, can be scratched by a steel file, possibly by a knife blade. Heavy weight.

CLEAVAGE: perfect in three directions, yielding small cubes; brittle.

Cobaltite

Reddish-brown.

LUSTER: submetallic; resinous; bluish tint on fresh fracture; opaque to faintly translucent.

STREAK: dark red to brown to black.

HARDNESS: 6, can be scratched by a steel file. Heavy weight.

CLEAVAGE: good parallel to side; brittle.

Columbite

Copper-red, often with green spots, or black with tarnish.

LUSTER: metallic; dull when tarnished; opaque.

STREAK: copper-red.

HARDNESS: 2½–3, can be scratched by a knife blade, possibly by a copper coin; malleable, can be twisted with tools. Very heavy.

FRACTURE: rough, hackly.

Copper

Pink, red.

LUSTER: nonmetallic; sparkling to glassy to dull; transparent to translucent to opaque.

STREAK: colorless.

HARDNESS: 9, easily scratches quartz. Heavy weight.

FRACTURE: shell-like to uneven; brittle.

NOTE: may fluoresce in ultraviolet light.

Corundum

RED

THE ROCK-HUNTER'S FIELD MANUAL

Red, ruby-red, reddish-brown, reddish-gray, often with green or blue spots.

LUSTER: metallic; clear crystals have diamond-like sparkle; transparent to translucent.

STREAK: brownish-red to brick-red.

HARDNESS: $3\frac{1}{2}$ –4, can be scratched by a knife blade. Medium weight.

FRACTURE: uneven; brittle.

Cuprite

Pale red.

LUSTER: nonmetallic; sparkling to dull; greasy; transparent to translucent; opaque in dark colors.

STREAK: colorless.

HARDNESS: 10 or over, easily scratches quartz. Medium weight.

CLEAVAGE: perfect in four directions, yielding fragments similar to figure 30; brittle.

NOTE: may fluoresce in ultraviolet light. If a crystal is rubbed, it may generate enough electricity to pick up tiny bits of paper.

Diamond

Flesh-pink.

LUSTER: nonmetallic; glassy, pearly; transparent, or translucent to opaque.

STREAK: colorless.

HARDNESS: $3\frac{1}{2}$ –4, can be scratched by a knife blade, possibly by a copper coin. Medium weight.

CLEAVAGE: good in three directions, yielding fragments similar to figure 21; brittle.

Dolomite

Pink, red. Very distinctive colors.

LUSTER: nonmetallic; glassy; transparent to translucent.

STREAK: colorless.

HARDNESS: 7, can be scratched by quartz. Medium weight.

CLEAVAGE: parallel to length of fibers; poor.

Dumortierite

Rose.

LUSTER: nonmetallic; glassy; transparent to translucent.

STREAK: colorless to white.

HARDNESS: 4, can be scratched by a knife blade. Medium weight.

CLEAVAGE: perfect in four directions, yielding fragments similar to figure 30.

NOTE: will generally fluoresce in ultraviolet light.

Fluorite*Red, reddish-brown, deep red.*

LUSTER: nonmetallic; glassy to resinous; transparent to translucent, occasionally opaque.

STREAK: colorless to white.

HARDNESS: $6\frac{1}{2}$ – $7\frac{1}{2}$; can be scratched by quartz at 7 and under; over 7 will scratch quartz. Heavy weight.

FRACTURE: uneven.

Garnet*Reddish, orange-red.*

LUSTER: nonmetallic; sparkling to resinous to earthy; transparent to translucent.

STREAK: dark orange-yellow to pale brick-red.

HARDNESS: 3 – $3\frac{1}{2}$, can be scratched by a knife blade, possibly by a copper coin. Heavy weight.

FRACTURE: shell-like; brittle.

Greenockite*Red.*

LUSTER: nonmetallic; glassy, silky, or pearly; transparent to translucent to opaque.

STREAK: colorless to white.

HARDNESS: $1\frac{1}{2}$ – 2 , can be scratched by the fingernail. Medium weight.

CLEAVAGE: perfect parallel to side of crystal.

NOTE: may fluoresce in ultraviolet light.

Gypsum*Red.*

LUSTER: nonmetallic; glassy; transparent to translucent.

RED

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STREAK: colorless.

HARDNESS: 2½, can be scratched by a copper coin, possibly by the fingernail. Light weight.

CLEAVAGE: perfect in three directions, yielding small square blocks; somewhat brittle.

NOTE: soluble in water; a small piece will melt in a candle flame. May fluoresce in ultraviolet light.

Halite

Red, reddish-brown.

LUSTER: brilliant metallic and translucent in crystalline variety; submetallic, dull, opaque in earthy variety.

STREAK: Indian-red to reddish-brown.

HARDNESS: 1-2½ in soft variety, can be scratched by the fingernail; 5½-6½ in harder ore, can be scratched by a steel file, possibly by a knife blade; may scratch glass. Medium weight.

FRACTURE: uneven; brittle.

NOTE: may be slightly magnetic.

Hematite

Red.

LUSTER: nonmetallic; dull earthy; pearly in plates; opaque in masses.

STREAK: white.

HARDNESS: 2-2½, can be scratched by the fingernail. Medium weight.

CLEAVAGE: parallel to base, yielding thin flexible plates.

NOTE: feels smooth, greasy; has strong clay odor when slightly damp.

Kaolinite

Pink.

LUSTER: nonmetallic; pearly; translucent.

STREAK: colorless.

HARDNESS: 2½-4, can be scratched by a knife blade, possibly by a copper coin. Medium weight.

CLEAVAGE: perfect parallel to base.

Lepidolite

Red.

LUSTER: nonmetallic; glassy; occasionally pearly; transparent to translucent.

STREAK: colorless.

HARDNESS: 6, can be scratched by a steel file. Medium weight.

CLEAVAGE: parallel to base and side; brittle.

NOTE: may fluoresce in ultraviolet light.

Microcline*Red, reddish-brown.*

LUSTER: nonmetallic; glassy to resinous; transparent to translucent, occasionally opaque.

STREAK: colorless to yellowish or brownish.

HARDNESS: 5-5½, can be scratched by a knife blade. Heavy weight.

FRACTURE: shell-like to uneven; brittle.

NOTE: radioactive.

Monazite*Light red.*

LUSTER: nonmetallic; glassy, pearly, silky; transparent to translucent.

STREAK: colorless.

HARDNESS: 2-2½, can be scratched by the fingernail. Medium weight.

CLEAVAGE: perfect parallel to base, yielding very thin flexible and elastic plates.

Muscovite*Light red.*

LUSTER: nonmetallic; glassy; transparent to translucent.

STREAK: colorless.

HARDNESS: 5-5½, can be scratched by a knife blade. Light weight.

CLEAVAGE: perfect parallel to base and side.

Natrolite*Red, possibly showing internal reflections of orange to red.*

LUSTER: nonmetallic; glassy, waxy, pearly; transparent to translucent to opaque.

RED

STREAK: white to colorless.

HARDNESS: 5-6½, can be scratched by a steel file, possibly by a knife blade; may scratch glass. Light weight.

FRACTURE: shell-like, leaving smooth surface.

NOTE: may fluoresce in ultraviolet light.

Opal

Flesh-pink, red.

LUSTER: nonmetallic; glassy, waxy; transparent to translucent.

STREAK: white.

HARDNESS: 6, can be scratched by a steel file. Medium weight.

CLEAVAGE: parallel to base and side, with cleavage lines meeting at a 90° angle.

Orthoclase

Rose-red, pink.

LUSTER: nonmetallic; glassy in crystals, greasy in rock-like masses; transparent to translucent to opaque.

STREAK: colorless, white, or very light colored.

HARDNESS: 7, can scratch glass and be scratched by quartz. Medium weight.

FRACTURE: shell-like; brittle.

NOTE: horizontal lines or grooves on crystals.

Quartz

Flesh-pink, rose-red.

LUSTER: nonmetallic; glassy to pearly; transparent to translucent to opaque.

STREAK: white to colorless.

HARDNESS: 3½-4½, can be scratched by a knife blade. Medium weight.

CLEAVAGE: perfect in three directions, with cleavage lines meeting at oblique angles.

Rhodochrosite

Rose-red, pink. Often with dark spots.

LUSTER: nonmetallic; glassy to pearly; transparent to translucent to opaque.

STREAK: colorless to white, or very slightly colored.

HARDNESS: 5½–6, can be scratched by a steel file, possibly by a knife blade. Medium weight.

CLEAVAGE: good in two directions, with cleavage lines meeting at an angle of near 90°.

Rhodonite

Deep red, reddish-yellow, reddish-brown.

LUSTER: brilliant metallic to submetallic; transparent to translucent to opaque.

STREAK: pale brown.

HARDNESS: 6–6½, can be scratched by a steel file; will scratch glass. Heavy weight.

FRACTURE: uneven; brittle.

Rutile

Reddish. Often has a mottled appearance.

LUSTER: nonmetallic; greasy, waxy; silky in fibrous variety; translucent to opaque.

STREAK: white or colorless, possible glassy appearance.

HARDNESS: 2½–4 (5), can be scratched by a copper coin in soft varieties, or by a knife blade. Medium weight.

FRACTURE: splintery to shell-like.

NOTE: feels smooth, sometimes soapy.

Serpentine

Red to pink.

LUSTER: nonmetallic; glassy; translucent to opaque.

STREAK: colorless to whitish.

HARDNESS: 5, can be scratched by a knife blade. Heavy weight.

CLEAVAGE: good in three directions, yielding fragments similar to figure 21; cleavage lines not always distinct; brittle

Smithsonite

Red.

LUSTER: nonmetallic; resinous to sparkling; transparent to translucent to opaque.

STREAK: brown to yellowish to whitish.

RED

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HARDNESS: $3\frac{1}{2}$ –4, can be scratched by a knife blade. Heavy weight.

CLEAVAGE: perfect in six directions, yielding fragments similar to figure 28.

NOTE: may fluoresce in ultraviolet light.

Sphalerite

Red, deep red, rose-red, bluish-red, reddish-yellow.

LUSTER: nonmetallic; glassy, sparkling; transparent to translucent, may be opaque in dark colors.

STREAK: white.

HARDNESS: 8, will scratch quartz. Medium weight.

FRACTURE: shell-like; brittle.

Spinel

Pink.

LUSTER: nonmetallic; glassy to pearly on cleavage surface; transparent to translucent.

STREAK: colorless to white.

HARDNESS: $6\frac{1}{2}$ –7, can be scratched by quartz. Medium weight.

CLEAVAGE: perfect parallel to base and side, with cleavage lines meeting at an angle of near 90° ; brittle.

NOTE: a crystal may show different colors when held to a light and turned. May fluoresce in ultraviolet light.

Spodumene

Reddish-brown.

LUSTER: nonmetallic; resinous to dull glassy; translucent to opaque, occasionally transparent.

STREAK: colorless to light gray.

HARDNESS: 7– $7\frac{1}{2}$, will scratch quartz. Medium weight.

FRACTURE: shell-like, rough; brittle.

NOTE: a small piece will appear blood-red or orange when held to a light.

Staurolite

Red.

LUSTER: nonmetallic; glassy; pearly on cleavage surface; translucent, occasionally transparent.

STREAK: colorless.

HARDNESS: 3½–4, can be scratched by a knife blade. Light weight.

CLEAVAGE: parallel to length.

Stilbite

Reddish-yellow.

LUSTER: nonmetallic; resinous; transparent to translucent.

STREAK: pale yellow to white.

HARDNESS: 1½–2½, can be scratched by the fingernail and easily cut with a knife. Light weight.

FRACTURE: shell-like to uneven; brittle.

NOTE: if a crystal is rubbed, it may generate enough electricity to pick up tiny bits of paper.

Sulphur

Reddish, orange-yellow. May have orange-yellow to brownish-yellow streaks.

LUSTER: nonmetallic; glassy, resinous, greasy; transparent to translucent to opaque.

STREAK: brown to black in thorite, orange-yellow in orange-ite.

HARDNESS: 4½–5, can be scratched by a knife blade. Heavy weight.

FRACTURE: shell-like.

NOTE: radioactive.

Thorite

Pink.

LUSTER: nonmetallic; glassy; transparent, occasionally translucent.

STREAK: colorless.

HARDNESS: 8, will scratch quartz. Medium weight.

CLEAVAGE: perfect parallel to base; brittle.

NOTE: if a crystal is rubbed, it will generate enough electricity to pick up tiny bits of paper. May fluoresce in ultraviolet light.

Topaz

RED

Pink, red.

LUSTER: nonmetallic; glassy to resinous; transparent to translucent to opaque.

STREAK: colorless.

HARDNESS: 7-7½, will scratch quartz. Medium weight.

FRACTURE: shell-like to uneven; brittle.

NOTE: a crystal will show different colors when held to a light and turned. May fluoresce in ultraviolet light.

Tourmaline

Ruby red, reddish-brown.

LUSTER: nonmetallic; resinous to sparkling; translucent to opaque, occasionally transparent.

STREAK: colorless to yellowish or white.

HARDNESS: 3, can be scratched by a copper coin. Heavy weight.

FRACTURE: rough, uneven; brittle.

Vanadinite

Flesh-red, reddish-brown.

LUSTER: nonmetallic; glassy to resinous; transparent to translucent.

STREAK: colorless.

HARDNESS: 5½, can be scratched by a steel file, possibly by a knife blade. Heavy weight.

FRACTURE: shell-like to uneven; brittle.

NOTE: may show flashes of light when struck with a hammer or scratched with a sharp instrument. Highly fluorescent in ultraviolet light.

Willemite

Brownish-red.

LUSTER: metallic to submetallic; often resinous; opaque.

STREAK: brown to black.

HARDNESS: 5-5½, can be scratched by a steel file, possibly by a knife blade. Very heavy

CLEAVAGE: perfect parallel to side; brittle.

NOTE: bright red in thin splinters.

Wolframite

Rose-red.

LUSTER: nonmetallic; glassy; silky when fibrous; pearly on cleavage surface; faintly transparent to translucent.

STREAK: colorless to whitish to grayish.

HARDNESS: $4\frac{1}{2}$ –5, can be scratched by a knife blade. Medium weight.

CLEAVAGE: parallel to front and base; brittle.

NOTE: may fluoresce in ultraviolet light.

Wollastonite*Pink, reddish, reddish-brown.*

LUSTER: nonmetallic; diamond-like sparkle; translucent to opaque, occasionally transparent.

STREAK: colorless.

HARDNESS: $7\frac{1}{2}$, will scratch quartz. Heavy weight.

FRACTURE: shell-like; brittle.

Zircon*Pink, rose-red.*

LUSTER: nonmetallic; glassy, pearly on cleavage surface; transparent to translucent.

STREAK: colorless.

HARDNESS: 6 – $6\frac{1}{2}$, can be scratched by quartz, possibly by a steel file. Medium weight.

CLEAVAGE: parallel to length; brittle.

NOTE: may fluoresce in ultraviolet light.

Zoisite

WHITE

White, may show bluish-white opalescence.

LUSTER: nonmetallic; glassy to pearly; transparent to translucent.

STREAK: colorless.

HARDNESS: 6 – $6\frac{1}{2}$, can be scratched by quartz, possibly by a steel file. Medium weight.

CLEAVAGE: in two directions, with cleavage lines meeting at an angle of near 90° ; brittle.

NOTE: may fluoresce in ultraviolet light.

Albite

WHITE

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White.

LUSTER: nonmetallic; glassy; pearly on cleavage surface; translucent to transparent.

STREAK: white.

HARDNESS: 6, can be scratched by a steel file. Medium weight.

CLEAVAGE: perfect parallel to base; brittle.

Amblygonite

White.

LUSTER: nonmetallic; glassy; transparent to translucent.

STREAK: colorless.

HARDNESS: 5-5½, can be scratched by a steel file, possibly by a knife blade. Medium weight.

FRACTURE: usually even; brittle.

NOTE: when rubbed or slightly heated, the crystals may generate enough electricity to pick up bits of paper.

Analcite

White.

LUSTER: nonmetallic; glassy; translucent to opaque, occasionally transparent.

STREAK: colorless.

HARDNESS: 7½, will scratch quartz. Medium weight.

FRACTURE: uneven; brittle.

NOTE: some crystals will show red in one direction and green in another when held to a light and turned.

Andalusite

White.

LUSTER: nonmetallic; diamond-like sparkle when crystalline, dull when earthy; transparent to opaque.

STREAK: colorless.

HARDNESS: 3, can be scratched by a copper coin. Very heavy.

CLEAVAGE: parallel to base and side; poor.

FRACTURE: shell-like; brittle.

NOTE: may fluoresce in ultraviolet light.

Anglesite

White.

LUSTER: nonmetallic; glassy; pearly on cleavage surfaces; transparent to translucent.

STREAK: colorless to grayish-white.

HARDNESS: 3-3½, can be scratched by a copper coin and cut with a knife. Medium weight.

CLEAVAGE: good in three directions, with cleavage lines meeting at right angles, yielding rectangular blocks; brittle.

Anhydrite

White; frequently has patchy or melted appearance.

LUSTER: nonmetallic; glassy, resinous, greasy; transparent to translucent to opaque.

STREAK: colorless to white.

HARDNESS: 5, can be scratched easily by a steel file, possibly by a knife blade. Medium weight.

CLEAVAGE: parallel to base and side; poor.

FRACTURE: shell-like; brittle.

NOTE: may fluoresce in ultraviolet light.

Apatite*White.*

LUSTER: nonmetallic; glassy; transparent to translucent to opaque.

STREAK: colorless.

HARDNESS: 3½-4, can be scratched by a knife blade. Medium weight.

CLEAVAGE: parallel to length of crystals or columns; poor.

FRACTURE: shell-like to uneven; brittle.

NOTE: will become powdery when held in a candle flame.

May fluoresce in ultraviolet light.

Aragonite*Silver-white.*

LUSTER: metallic; will tarnish after exposure to air; opaque.

STREAK: grayish-black to black.

HARDNESS: 5½-6, can be scratched by a steel file; may scratch glass. Medium weight.

FRACTURE: uneven; brittle.

WHITE

NOTE: garlic smell noticeable when struck with a hammer.

Arsenopyrite

White.

LUSTER: nonmetallic; glassy; transparent to translucent.

STREAK: colorless.

HARDNESS: $6\frac{1}{2}$ -7, can be scratched by quartz. Medium weight.

FRACTURE: shell-like.

NOTE: may fluoresce in ultraviolet light.

Axinite

White.

LUSTER: nonmetallic; glassy; pearly on cleavage surface; transparent to translucent.

STREAK: white or colorless.

HARDNESS: $3-3\frac{1}{2}$, can be scratched by a knife blade, possibly by a copper coin. Heavy weight.

CLEAVAGE: perfect parallel to base; brittle.

NOTE: may fluoresce in ultraviolet light.

Barite

White.

LUSTER: nonmetallic; dull, earthy; translucent to opaque.

STREAK: colorless.

HARDNESS: 1-3, can be scratched by a copper coin, possibly by the fingernail. Medium weight.

FRACTURE: earthy.

NOTE: may fluoresce in ultraviolet light.

Bauxite

White. May have frosted or mottled appearance.

LUSTER: nonmetallic; glassy; transparent to translucent, occasionally opaque.

STREAK: white or colorless.

HARDNESS: $7\frac{1}{2}$ -8, will scratch quartz. Medium weight.

CLEAVAGE: parallel to base; poor.

FRACTURE: shell-like to uneven; brittle.

Beryl

White.

LUSTER: nonmetallic; glassy, pearly, dull; translucent to opaque.

STREAK: white.

HARDNESS: 2-2½, can be scratched by a copper coin. Light weight.

CLEAVAGE: parallel to front of crystal.

NOTE: soluble in water; will melt in a candle flame. May fluoresce in ultraviolet light.

Borax*Silver-white.*

LUSTER: metallic; opaque.

STREAK: greenish-gray to yellowish-gray.

HARDNESS: 2½, can be scratched by a copper coin, possibly by the fingernail. Very heavy.

FRACTURE: uneven; very brittle.

NOTE: a small piece will melt in a candle flame.

Calaverite*White.*

LUSTER: nonmetallic; glassy to earthy; transparent to translucent.

STREAK: white to gray.

HARDNESS: 3, can be scratched by a copper coin. Medium weight.

CLEAVAGE: perfect in three directions at oblique angles, yielding smooth-surfaced fragments similar to figure 21.

NOTE: will frequently fluoresce in ultraviolet light.

Calcite*White.*

LUSTER: nonmetallic; brilliant sparkle in crystals to dull in masses; translucent to opaque, rarely transparent.

STREAK: white to very pale brown.

HARDNESS: 6-7, can be scratched by quartz, possibly by a steel file. Very heavy.

FRACTURE: rough, uneven.

Cassiterite

White.

LUSTER: nonmetallic; glassy to pearly; transparent to translucent to opaque.

STREAK: colorless to white.

HARDNESS: 3–3½, can be scratched by a knife blade, possibly by a copper coin. Heavy weight.

CLEAVAGE: perfect parallel to base.

NOTE: may fluoresce in ultraviolet light.

Celestite*White.*

LUSTER: nonmetallic; diamond-like sparkle; transparent to translucent.

STREAK: white or colorless.

HARDNESS: 3–3½, can be scratched by a knife blade, possibly by a copper coin. Very heavy

FRACTURE: shell-like; very brittle.

NOTE: a small splinter can be melted in a candle flame.

Cerussite

White, reddish-white, bands of white and black or white and reddish-brown.

LUSTER: nonmetallic; waxy, glassy, dull; transparent to translucent.

STREAK: colorless.

HARDNESS: 7, can be scratched by quartz. Medium weight.

FRACTURE: shell-like; brittle.

Chalcedony*White.*

LUSTER: nonmetallic; glassy to pearly; translucent to opaque, occasionally transparent.

STREAK: colorless to white to pale green.

HARDNESS: 2–2½, can be scratched by the fingernail. Medium weight.

CLEAVAGE: perfect parallel to base, yielding plates that are flexible but not elastic.

Chlorite

Silver-white, white with reddish tint.

LUSTER: metallic; opaque.

STREAK: grayish-black.

HARDNESS: $5\frac{1}{2}$, can be scratched by a steel file, possibly by a knife blade. Heavy weight.

CLEAVAGE: perfect in three directions, yielding small cubes; brittle.

Cobaltite

White.

LUSTER: nonmetallic; glassy; transparent to translucent.

STREAK: white or colorless.

HARDNESS: $4-4\frac{1}{2}$, can be scratched by a knife blade. Medium weight.

CLEAVAGE: good parallel to length; brittle.

NOTE: may break apart in a candle flame; may fluoresce in ultraviolet light.

Colemanite

Whitish-gray.

LUSTER: nonmetallic; glassy; transparent to translucent.

STREAK: colorless.

HARDNESS: $7-7\frac{1}{2}$, will scratch quartz. Medium weight.

FRACTURE: shell-like to uneven.

NOTE: some crystals will show various colors when held to a light and turned.

Cordierite

White.

LUSTER: nonmetallic; sparkling to glassy to dull; transparent to translucent to opaque.

STREAK: colorless.

HARDNESS: 9, easily scratches quartz. Heavy weight.

FRACTURE: shell-like to uneven; brittle.

NOTE: may fluoresce in ultraviolet light.

Corundum

White.

LUSTER: nonmetallic; sparkling to dull; greasy; transparent to translucent; opaque in dark colors.

WHITE

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STREAK: colorless.

HARDNESS: 10 or over, easily scratches quartz. Medium weight.

CLEAVAGE: perfect in four directions, yielding fragments similar to figure 30; brittle.

NOTE: may fluoresce in ultraviolet light. If a crystal is rubbed, it may generate enough electricity to pick up tiny bits of paper.

Diamond

White, grayish-white.

LUSTER: nonmetallic; glassy to dull, translucent, occasionally transparent.

STREAK: colorless.

HARDNESS: 5-6, can be scratched by a steel file, possibly by a knife blade. Medium weight.

CLEAVAGE: fair parallel to base and side, with cleavage lines meeting at an angle of near 90°

Diopside

White.

LUSTER: nonmetallic; glassy, pearly; transparent, or translucent to opaque.

STREAK: colorless.

HARDNESS: 3½-4, can be scratched by a knife blade, possibly by a copper coin. Medium weight.

CLEAVAGE: good in three directions, yielding fragments similar to figure 21; brittle.

Dolomite

White.

LUSTER: nonmetallic; glassy; transparent to translucent.

STREAK: colorless or white.

HARDNESS: 4, can be scratched by a knife blade. Medium weight.

CLEAVAGE: perfect in four directions, yielding fragments similar to figure 30.

NOTE: will generally fluoresce in ultraviolet light.

Fluorite

White.

LUSTER: nonmetallic; glassy to resinous; transparent to translucent, occasionally opaque.

STREAK: colorless to white.

HARDNESS: $6\frac{1}{2}$ – $7\frac{1}{2}$, can be scratched by quartz at 7 and under; over 7 will scratch quartz. Heavy weight.

FRACTURE: uneven.

Garnet*White, greenish-white.*

LUSTER: nonmetallic; dull, earthy

STREAK: colorless.

HARDNESS: 2–3, can be scratched by the fingernail. Medium weight.

FRACTURE: uneven; crumbly.

Garnierite*White.*

LUSTER: nonmetallic; glassy, silky, or pearly; transparent to translucent to opaque.

STREAK: colorless to white.

HARDNESS: $1\frac{1}{2}$ –2, can be scratched by the fingernail. Medium weight.

CLEAVAGE: perfect parallel to side of crystal.

NOTE: may fluoresce in ultraviolet light.

Gypsum*White.*

LUSTER: nonmetallic; glassy; transparent to translucent.

STREAK: colorless.

HARDNESS: $2\frac{1}{2}$, can be scratched by a copper coin, possibly by the fingernail. Light weight.

CLEAVAGE: perfect in three directions, yielding small square blocks; somewhat brittle.

NOTE: soluble in water; a small piece will melt in a candle flame. May fluoresce in ultraviolet light.

Halite*White.*

LUSTER: nonmetallic; sparkling, glassy, pearly; transparent to translucent.

WHITE

STREAK: white.

HARDNESS: $4\frac{1}{2}$ -5, can be scratched by a knife blade. Medium weight.

CLEAVAGE: parallel to base and side; brittle.

NOTE: will frequently fluoresce in ultraviolet light.

Hemimorphite

White, may have grayish streaks.

LUSTER: nonmetallic; glassy to resinous; subtranslucent to translucent, occasionally transparent.

STREAK: white.

HARDNESS: $6\frac{1}{2}$, can be scratched by quartz, possibly by a steel file. Medium weight.

FRACTURE: roughly shell-like; brittle.

Idocrase

White, white with green markings. May have light brown coating.

LUSTER: nonmetallic; waxy, glassy, pearly; translucent to opaque.

STREAK: colorless.

HARDNESS: $6\frac{1}{2}$ -7, may be scratched by quartz. Medium weight.

CLEAVAGE: fair parallel to base and side, with cleavage lines meeting at an angle of near 90° .

FRACTURE: splintery, may be hard to break.

Jadeite

White.

LUSTER: nonmetallic; dull earthy; pearly in plates; opaque in masses.

STREAK: white.

HARDNESS: 2- $2\frac{1}{2}$, can be scratched by the fingernail. Medium weight.

CLEAVAGE: parallel to base, yielding thin flexible plates.

NOTE: feels smooth, greasy; has strong clay odor when slightly damp.

Kaolinite

White.

LUSTER: nonmetallic; glassy to pearly; transparent to translucent.

STREAK: colorless to white.

HARDNESS: 3, can be scratched by a copper coin. Light weight.

CLEAVAGE: parallel to side and base, yielding long splinters.

NOTE: soluble in water.

Kernite*White. May have blotchy appearance.*

LUSTER: nonmetallic; glassy to pearly; transparent to translucent.

STREAK: colorless to whitish.

HARDNESS: 5 parallel to length of crystal, can be scratched by a knife blade; 7 across width of crystal, can be scratched by quartz. Medium weight.

CLEAVAGE: perfect parallel to length of crystals.

NOTE: crystals are generally darker in color toward the center.

Kyanite*White.*

LUSTER: nonmetallic; pearly; translucent.

STREAK: colorless.

HARDNESS: 2½–4, can be scratched by a knife blade, possibly by a copper coin. Medium weight.

CLEAVAGE: perfect parallel to base.

Lepidolite*White.*

LUSTER: nonmetallic; glassy to dull; transparent to opaque.

STREAK: white to colorless.

HARDNESS: 3½–5, can be scratched by a knife blade. Medium weight.

CLEAVAGE: three perfect with cleavage lines meeting at oblique angles in crystalline variety.

FRACTURE: shell-like in noncrystalline variety; brittle.

Magnesite

WHITE

Whitish on fresh fracture, yellowish-brown tarnish.

LUSTER: metallic; opaque.

STREAK: grayish-black to brownish-black.

HARDNESS: 6-6½, can be scratched by a steel file; may scratch glass. Medium weight.

FRACTURE: uneven; brittle.

Marcasite

White, ivory.

LUSTER: nonmetallic; glassy; occasionally pearly; transparent to translucent.

STREAK: colorless.

HARDNESS: 6, can be scratched by a steel file. Medium weight.

CLEAVAGE: parallel to base and side; brittle.

NOTE: may fluoresce in ultraviolet light.

Microcline

White.

LUSTER: nonmetallic; glassy; transparent to translucent.

STREAK: colorless.

HARDNESS: 5-5½, can be scratched by a knife blade. Light weight.

CLEAVAGE: perfect parallel to base and side.

Natrolite

White, possibly showing internal play of colors.

LUSTER: nonmetallic; glassy, waxy, pearly; transparent to translucent to opaque.

STREAK: white to colorless.

HARDNESS: 5-6½, can be scratched by a steel file, possibly by a knife blade; may scratch glass. Light weight.

FRACTURE: shell-like, leaving smooth surface.

NOTE: may fluoresce in ultraviolet light.

Opal

White. May show bluish-white opalescence.

LUSTER: nonmetallic; glassy, waxy; transparent to translucent.

STREAK: white.

HARDNESS: 6, can be scratched by a steel file. Medium weight.

CLEAVAGE: parallel to base and side, with cleavage lines meeting at a 90° angle.

Orthoclase

Grayish-white. May have rust-colored coating.

LUSTER: metallic; bright; opaque.

STREAK: light gray, shiny.

HARDNESS: 4-4½, can be scratched by a knife blade, hammered into thin sheets, and drawn into a wire. Extremely heavy.

FRACTURE: rough, hackly.

NOTE: may be slightly magnetic.

Platinum

White.

LUSTER: nonmetallic; glassy; translucent, occasionally transparent.

STREAK: colorless.

HARDNESS: 6-6½, can be scratched by quartz, possibly by a steel file. Medium weight.

FRACTURE: rough, uneven; brittle.

Prehnite

Milky white, white.

LUSTER: nonmetallic; glassy in crystals, greasy in rock-like masses; transparent to translucent to opaque.

STREAK: white, colorless, or very light colored.

HARDNESS: 7, can scratch glass and be scratched by quartz. Medium weight.

FRACTURE: shell-like; brittle.

NOTE: horizontal lines or grooves on crystals.

Quartz

White.

LUSTER: nonmetallic; glassy to sparkling; translucent, occasionally transparent.

WHITE

THE ROCK-HUNTER'S FIELD MANUAL

STREAK: colorless to white.

HARDNESS: $4\frac{1}{2}$ -5, can be scratched by a knife blade. Very heavy.

CLEAVAGE: parallel to the pyramid; good.

NOTE: highly fluorescent in ultraviolet light.

Scheelite

Near-white. Often has a mottled appearance.

LUSTER: nonmetallic; greasy, waxy; silky in fibrous variety; translucent to opaque.

STREAK: white or colorless, possible glassy appearance.

HARDNESS: $2\frac{1}{2}$ -4 (5), can be scratched by a copper coin in soft varieties, or by a knife blade. Medium weight.

FRACTURE: splintery to shell-like.

NOTE: feels smooth, sometimes soapy.

Serpentine

White, grayish-white.

LUSTER: nonmetallic; glassy, satiny; translucent, occasionally transparent.

STREAK: colorless.

HARDNESS: 6-7, can be scratched by quartz, possibly by a steel file. Medium weight.

CLEAVAGE: parallel to length of crystals or fibers.

Sillimanite

Silver-white on fresh fracture; dark gray to grayish-black tarnish.

LUSTER: metallic; opaque.

STREAK: silver-white.

HARDNESS: $2\frac{1}{2}$ -3, can be scratched by a knife blade, hammered into thin sheets, and drawn into a wire. Very heavy.

FRACTURE: jagged, hackly.

Silver

White.

LUSTER: nonmetallic; glassy; translucent to opaque.

STREAK: colorless to whitish.

HARDNESS: 5, can be scratched by a knife blade. Heavy weight.

CLEAVAGE: good in three directions, yielding fragments similar to figure 21; cleavage lines not always distinct; brittle.
Smithsonite

White.

LUSTER: nonmetallic; resinous to sparkling; transparent to translucent to opaque.

STREAK: brown to yellowish to whitish.

HARDNESS: $3\frac{1}{2}$ –4, can be scratched by a knife blade. Heavy weight.

CLEAVAGE: perfect in six directions, yielding fragments similar to figure 28.

NOTE: may fluoresce in ultraviolet light.

Sphalerite*White.*

LUSTER: nonmetallic; glassy, sparkling; transparent to translucent, may be opaque in dark colors.

STREAK: white.

HARDNESS: 8, will scratch quartz. Medium weight.

FRACTURE: shell-like; brittle.

Spinel*White, grayish-white, greenish-white.*

LUSTER: nonmetallic; glassy to pearly on cleavage surface; transparent to translucent.

STREAK: colorless to white.

HARDNESS: $6\frac{1}{2}$ –7, can be scratched by quartz. Medium weight.

CLEAVAGE: perfect parallel to base and side, with cleavage lines meeting at an angle of near 90° ; brittle.

NOTE: a crystal may show different colors when held to a light and turned. May fluoresce in ultraviolet light.

Spodumene*White.*

LUSTER: nonmetallic; glassy; pearly on cleavage surface; translucent, occasionally transparent.

STREAK: colorless.

WHITE

THE ROCK-HUNTER'S FIELD MANUAL

HARDNESS: 3½-4, can be scratched by a knife blade. Light weight.

CLEAVAGE: parallel to length.

Stilbite

Silver-white.

LUSTER: metallic; brilliant; opaque.

STREAK: gray to grayish-black.

HARDNESS: 1½-2, can be scratched by the fingernail. Heavy weight.

CLEAVAGE: parallel to side of crystal.

NOTE: a small piece will melt in a candle flame.

Sylvanite

White, silvery-white.

LUSTER: nonmetallic; pearly, possibly greasy; translucent.

STREAK: white.

HARDNESS: 1-1½, can be scratched by the fingernail and easily carved with a knife. Medium weight.

CLEAVAGE: parallel to base, yielding scales or plates that are flexible but not elastic.

NOTE: may feel soapy or slippery.

Talc

White.

LUSTER: nonmetallic; glassy; transparent, occasionally translucent.

STREAK: colorless.

HARDNESS: 8, will scratch quartz. Medium weight.

CLEAVAGE: perfect parallel to base; brittle.

NOTE: if a crystal is rubbed, it will generate enough electricity to pick up tiny bits of paper. May fluoresce in ultraviolet light.

Topaz

White.

LUSTER: nonmetallic; glassy to resinous; transparent to translucent to opaque.

STREAK: colorless.

HARDNESS: 7-7½, will scratch quartz. Medium weight.

FRACTURE: shell-like to uneven; brittle.

NOTE: a crystal will show different colors when held to a light and turned. May fluoresce in ultraviolet light.

Tourmaline

White.

LUSTER: nonmetallic; silky in fibrous variety; glassy; pearly on cleavage surface; transparent to translucent.

STREAK: colorless to whitish or grayish.

HARDNESS: 5-6, can be scratched by a steel file, possibly by a knife blade. Medium weight.

CLEAVAGE: in two directions, with cleavage lines meeting at angles of 56° and 124°; often splintery.

Tremolite

White.

LUSTER: nonmetallic; glassy to resinous; transparent to translucent.

STREAK: colorless.

HARDNESS: 5½, can be scratched by a steel file, possibly by a knife blade. Heavy weight.

FRACTURE: shell-like to uneven; brittle.

NOTE: may show flashes of light when struck with a hammer or scratched with a sharp instrument. Highly fluorescent in ultraviolet light.

Willemite

White.

LUSTER: nonmetallic; glassy; silky when fibrous; pearly on cleavage surface; faintly transparent to translucent.

STREAK: colorless to whitish to grayish.

HARDNESS: 4½-5, can be scratched by a knife blade. Medium weight.

CLEAVAGE: parallel to front and base; brittle.

NOTE: may fluoresce in ultraviolet light.

Wollastonite

Grayish-white.

LUSTER: nonmetallic; glassy, pearly on cleavage surface; transparent to translucent.

YELLOW

THE ROCK-HUNTER'S FIELD MANUAL

STREAK: colorless.

HARDNESS: 6-6½, can be scratched by quartz, possibly by a steel file. Medium weight.

CLEAVAGE: parallel to length; brittle.

NOTE: may fluoresce in ultraviolet light.

Zoisite

YELLOW

Yellowish.

LUSTER: nonmetallic; glassy to pearly; transparent to translucent.

STREAK: colorless.

HARDNESS: 6-6½, can be scratched by quartz, possibly by a steel file. Medium weight.

CLEAVAGE: in two directions, with cleavage lines meeting at an angle of near 90°; brittle.

NOTE: may fluoresce in ultraviolet light.

Albite

Pale yellow.

LUSTER: nonmetallic; diamond-like sparkle when crystalline, dull when earthy; transparent to opaque.

STREAK: colorless.

HARDNESS: 3, can be scratched by a copper coin. Very heavy.

CLEAVAGE: parallel to base and side; poor.

FRACTURE: shell-like; brittle.

NOTE: may fluoresce in ultraviolet light.

Anglesite

Yellow; frequently has patchy or melted appearance.

LUSTER: nonmetallic; glassy, resinous, greasy; transparent to translucent to opaque.

STREAK: colorless to white.

HARDNESS: 5, can be scratched easily by a steel file, possibly by a knife blade. Medium weight.

CLEAVAGE: parallel to base and side; poor.

FRACTURE: shell-like; brittle.

NOTE: may fluoresce in ultraviolet light.

Apatite

Yellow.

LUSTER: nonmetallic; glassy; transparent to translucent to opaque.

STREAK: colorless.

HARDNESS: $3\frac{1}{2}$ –4, can be scratched by a knife blade. Medium weight.

CLEAVAGE: parallel to length of crystals or columns; poor.

FRACTURE: shell-like to uneven; brittle.

NOTE: will become powdery when held in a candle flame. May fluoresce in ultraviolet light.

Aragonite*Lemon-yellow, sulphur-yellow.*

LUSTER: nonmetallic; glassy, pearly, satiny; translucent.

STREAK: yellowish, possibly greenish.

HARDNESS: 2 – $2\frac{1}{2}$, can be scratched by a copper coin, possibly by the fingernail. Medium weight.

CLEAVAGE: parallel to base; brittle.

NOTE: radioactive; highly fluorescent in ultraviolet light.

Autunite*Yellow.*

LUSTER: nonmetallic; glassy; transparent to translucent.

STREAK: colorless.

HARDNESS: $6\frac{1}{2}$ –7, can be scratched by quartz. Medium weight.

FRACTURE: shell-like.

NOTE: may fluoresce in ultraviolet light.

Axinite*Yellow.*

LUSTER: nonmetallic; glassy; pearly on cleavage surface; transparent to translucent

STREAK: white or colorless.

HARDNESS: 3 – $3\frac{1}{2}$, can be scratched by a knife blade, possibly by a copper coin. Heavy weight.

CLEAVAGE: perfect parallel to base; brittle.

NOTE: may fluoresce in ultraviolet light.

Barite

Yellowish.

LUSTER: nonmetallic; dull, earthy; translucent to opaque.

STREAK: colorless.

HARDNESS: 1-3, can be scratched by a copper coin, possibly by the fingernail. Medium weight.

FRACTURE: earthy.

NOTE: may fluoresce in ultraviolet light.

Bauxite

Clear golden yellow. May have frosted or mottled appearance.

LUSTER: nonmetallic; glassy; transparent to translucent, occasionally opaque.

STREAK: white or colorless.

HARDNESS: 7½-8, will scratch quartz. Medium weight.

CLEAVAGE: parallel to base; poor.

FRACTURE: shell-like to uneven; brittle.

Beryl

Brass-yellow.

LUSTER: metallic; opaque.

STREAK: greenish-gray to yellowish-gray.

HARDNESS: 2½, can be scratched by a copper coin, possibly by the fingernail. Very heavy.

FRACTURE: uneven; very brittle.

NOTE: a small piece will melt in a candle flame.

Calaverite

Yellow.

LUSTER: nonmetallic; glassy to earthy; transparent to translucent.

STREAK: white to gray.

HARDNESS: 3, can be scratched by a copper coin. Medium weight.

CLEAVAGE: perfect in three directions at oblique angles, yielding smooth-surfaced fragments similar to figure 21.

NOTE: will frequently fluoresce in ultraviolet light.

Calcite

Yellow, chrome-yellow, lemon-yellow, canary-yellow, greenish-yellow.

LUSTER: nonmetallic; dull, earthy, pearly; opaque.

STREAK: pale yellow.

HARDNESS: 2-3, can be scratched by the fingernail. Heavy weight.

FRACTURE: granular, earthy.

NOTE: strongly radioactive; may fluoresce in ultraviolet light.

Carnotite

Yellow.

LUSTER: nonmetallic; brilliant sparkle in crystals to dull in masses; translucent to opaque; rarely transparent.

STREAK: white to very pale brown.

HARDNESS: 6-7, can be scratched by quartz, possibly by a steel file. Very heavy.

FRACTURE: rough, uneven.

Cassiterite

Yellowish-green.

LUSTER: nonmetallic; waxy, glassy, dull; transparent to translucent.

STREAK: colorless.

HARDNESS: 7, can be scratched by quartz. Medium weight.

FRACTURE: shell-like; brittle.

Chalcedony

Brass-yellow, occasionally iridescent with tarnish.

LUSTER: metallic; brilliant; opaque.

STREAK: greenish-black.

HARDNESS: 3½-4, can be scratched easily by a knife blade, yielding a green powder. Medium weight.

FRACTURE: uneven to shell-like; brittle.

NOTE: will become powdery when struck with a hammer.

Chalcopyrite

Yellow.

LUSTER: nonmetallic; glassy to pearly; translucent to opaque, occasionally transparent.

STREAK: colorless to white to pale green.

HARDNESS: 2-2½, can be scratched by the fingernail. Medium weight.

YELLOW

THE ROCK-HUNTER'S FIELD MANUAL

CLEAVAGE: perfect parallel to base, yielding plates that are flexible but not elastic.

Chlorite

Yellow, yellowish-green.

LUSTER: nonmetallic; glassy; transparent to translucent.

STREAK: colorless.

HARDNESS: 8½, easily scratches quartz. Medium weight.

CLEAVAGE: in two directions, with cleavage lines meeting at right angles; brittle.

Chrysoberyl

Yellow.

LUSTER: nonmetallic; sparkling to glassy to dull; transparent to translucent to opaque.

STREAK: colorless.

HARDNESS: 9, easily scratches quartz. Heavy weight.

FRACTURE: shell-like to uneven; brittle.

NOTE: may fluoresce in ultraviolet light.

Corundum

Pale yellow.

LUSTER: nonmetallic; sparkling to dull; greasy; transparent to translucent; opaque in dark colors.

STREAK: colorless.

HARDNESS: 10 or over, easily scratches quartz. Medium weight.

CLEAVAGE: perfect in four directions, yielding fragments similar to figure 30; brittle.

NOTE: may fluoresce in ultraviolet light. If a crystal is rubbed, it may generate enough electricity to pick up tiny bits of paper.

Diamond

Yellowish-green.

LUSTER: nonmetallic; glassy; pearly on cleavage surface, transparent to opaque.

STREAK: colorless to grayish-white.

HARDNESS: 6-7, can be scratched by quartz, possibly by a steel file. Medium weight.

CLEAVAGE: good parallel to length of crystals; brittle.

NOTE: a crystal will show green in one direction and brown in another when held to a light and turned.

Epidote

Yellow.

LUSTER: nonmetallic; glassy; transparent to translucent.

STREAK: colorless or white.

HARDNESS: 4, can be scratched by a knife blade. Medium weight.

CLEAVAGE: perfect in four directions, yielding fragments similar to figure 30.

NOTE: will generally fluoresce in ultraviolet light.

Fluorite

Yellow.

LUSTER: nonmetallic; glassy to resinous; transparent to translucent, occasionally opaque.

STREAK: colorless to white.

HARDNESS: $6\frac{1}{2}$ – $7\frac{1}{2}$, can be scratched by quartz at 7 and under; over 7 will scratch quartz. Heavy weight.

FRACTURE: uneven.

Garnet

Pale to golden yellow.

LUSTER: metallic; opaque.

STREAK: golden yellow.

HARDNESS: $2\frac{1}{2}$, can be scratched by a knife blade, leaving a smooth shining groove; malleable, can be dented by a strong finger pressure and flattened into thin sheets with a hammer. Very heavy.

FRACTURE: uneven.

Gold

Yellow, orange, orange-yellow.

LUSTER: nonmetallic; sparkling to resinous to earthy; transparent to translucent.

STREAK: dark orange-yellow to pale brick-red.

HARDNESS: 3 – $3\frac{1}{2}$, can be scratched by a knife blade, possibly by a copper coin. Heavy weight.

YELLOW

THE ROCK-HUNTER'S FIELD MANUAL

FRACTURE: shell-like; brittle.

Greenockite

Yellow.

LUSTER: nonmetallic; glassy, silky, or pearly; transparent to translucent to opaque.

STREAK: colorless to white.

HARDNESS: $1\frac{1}{2}$ -2, can be scratched by the fingernail. Medium weight.

CLEAVAGE: perfect parallel to side of crystal.

NOTE: may fluoresce in ultraviolet light.

Gypsum

Yellow.

LUSTER: nonmetallic; glassy; transparent to translucent.

STREAK: colorless.

HARDNESS: $2\frac{1}{2}$, can be scratched by a copper coin, possibly by the fingernail. Light weight.

CLEAVAGE: perfect in three directions, yielding small square blocks; somewhat brittle.

NOTE: soluble in water; a small piece will melt in a candle flame. May fluoresce in ultraviolet light.

Halite

Yellow, yellowish-green, sulphur-yellow. Sometimes has white or grayish streaks.

LUSTER: nonmetallic; glassy to resinous; subtranslucent to translucent, occasionally transparent.

STREAK: white.

HARDNESS: $6\frac{1}{2}$, can be scratched by quartz, possibly by a steel file. Medium weight.

FRACTURE: roughly shell-like; brittle.

Idocrase

Yellow.

LUSTER: nonmetallic; dull earthy; pearly in plates; opaque in masses.

STREAK: white.

HARDNESS: $2-2\frac{1}{2}$, can be scratched by the fingernail. Medium weight.

COLOR KEY**YELLOW**

CLEAVAGE: parallel to base, yielding thin flexible plates.

NOTE: feels smooth, greasy; has strong clay odor when slightly damp.

Kaolinite

Yellow, brownish-yellow.

LUSTER: submetallic; glassy; dull to earthy; nearly opaque.

STREAK: yellowish-brown.

HARDNESS: 5–5½, can be scratched by a steel file, possibly by a knife blade. Medium weight.

FRACTURE: granular.

NOTE: generally becomes magnetic after being heated.

Limonite

Yellow.

LUSTER: nonmetallic; glassy to dull; transparent to opaque.

STREAK: white to colorless.

HARDNESS: 3½–5, can be scratched by a knife blade. Medium weight.

CLEAVAGE: three perfect with cleavage lines meeting at oblique angles in crystalline variety.

FRACTURE: shell-like in noncrystalline variety; brittle.

Magnesite

Pale brassy yellow on fresh fracture, may have yellowish-brown tarnish.

LUSTER: metallic; opaque.

STREAK: grayish-black to brownish-black.

HARDNESS: 6–6½, can be scratched by a steel file; may scratch glass. Medium weight.

FRACTURE: uneven; brittle.

Marcasite

Pale yellow, ivory.

LUSTER: nonmetallic; glassy; occasionally pearly; transparent to translucent.

STREAK: colorless.

HARDNESS: 6, can be scratched by a steel file. Medium weight.

CLEAVAGE: parallel to base and side; brittle.

YELLOW

NOTE: may fluoresce in ultraviolet light.

Microcline

Yellowish-brown.

LUSTER: nonmetallic; glassy to resinous; transparent to translucent, occasionally opaque.

STREAK: colorless to yellowish or brownish.

HARDNESS: 5-5½, can be scratched by a knife blade. Heavy weight.

FRACTURE: shell-like to uneven; brittle.

NOTE: radioactive.

Monazite

Pale yellow.

LUSTER: nonmetallic; glassy, pearly, silky; transparent to translucent.

STREAK: colorless.

HARDNESS: 2-2½, can be scratched by the fingernail. Medium weight.

CLEAVAGE: perfect parallel to base, yielding very thin flexible and elastic plates.

Muscovite

Light yellow.

LUSTER: nonmetallic; glassy; transparent to translucent.

STREAK: colorless.

HARDNESS: 5-5½, can be scratched by a knife blade. Light weight.

CLEAVAGE: perfect parallel to base and side.

Natrolite

Yellowish-green.

LUSTER: nonmetallic; glassy; transparent to translucent.

STREAK: colorless.

HARDNESS: 6½-7, can be scratched by quartz. Medium weight.

FRACTURE: shell-like; brittle.

Olivine

Yellow, possibly showing internal play of colors.

LUSTER: nonmetallic; glassy, waxy, pearly; transparent to translucent to opaque.

STREAK: white to colorless.

HARDNESS: 5-6½, can be scratched by a steel file, possibly by a knife blade; may scratch glass. Light weight.

FRACTURE: shell-like, leaving smooth surface.

NOTE: may fluoresce in ultraviolet light.

Opal

Pale yellow. May show bluish-white opalescence.

LUSTER: nonmetallic; glassy, waxy; transparent to translucent.

STREAK: white.

HARDNESS: 6, can be scratched by a steel file. Medium weight.

CLEAVAGE: parallel to base and side, with cleavage lines meeting at a 90° angle.

Orthoclase

Bronze-yellow.

LUSTER: metallic; opaque.

STREAK: brownish-bronze.

HARDNESS: 3½-4, can be scratched by a knife blade. Medium weight.

FRACTURE: shell-like; brittle.

Pentlandite

Yellowish-green.

LUSTER: nonmetallic; glassy; translucent, occasionally transparent.

STREAK: colorless.

HARDNESS: 6-6½, can be scratched by quartz, possibly by a steel file. Medium weight.

FRACTURE: rough, uneven; brittle.

Prehnite

Pale brass-yellow.

LUSTER: bright metallic; dull if tarnished; opaque.

YELLOW

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STREAK: greenish-black to brownish-black.

HARDNESS: 6-6½, can be scratched by quartz; may scratch glass. Medium weight.

FRACTURE: shell-like to uneven; brittle.

Pyrite

Light yellow, grayish-yellow, smoky-yellow.

LUSTER: nonmetallic; glassy in crystals, greasy in rock-like masses; transparent to translucent to opaque.

STREAK: white, colorless, or very light colored.

HARDNESS: 7, can scratch glass and be scratched by quartz. Medium weight.

FRACTURE: shell-like; brittle.

NOTE: horizontal lines or grooves on crystals.

Quartz

Reddish-yellow.

LUSTER: brilliant metallic to submetallic; transparent to translucent to opaque.

STREAK: pale brown.

HARDNESS: 6-6½, can be scratched by a steel file; will scratch glass. Heavy weight.

FRACTURE: uneven; brittle.

Rutile

Yellow.

LUSTER: nonmetallic; glassy to sparkling; translucent, occasionally transparent.

STREAK: colorless to white.

HARDNESS: 4½-5, can be scratched by a knife blade. Very heavy.

CLEAVAGE: parallel to the pyramid; good.

NOTE: highly fluorescent in ultraviolet light.

Scheelite

Yellowish-green. Often has a mottled appearance.

LUSTER: nonmetallic; greasy, waxy; silky in fibrous variety; translucent to opaque.

STREAK: white or colorless, possible glassy appearance.

HARDNESS: $2\frac{1}{2}$ –4(5), can be scratched by a copper coin in soft varieties, or by a knife blade. Medium weight.

FRACTURE: splintery to shell-like.

NOTE: feels smooth, sometimes soapy.

Serpentine

Yellow.

LUSTER: nonmetallic; glassy; translucent to opaque.

STREAK: colorless to whitish.

HARDNESS: 5, can be scratched by a knife blade. Heavy weight.

CLEAVAGE: good in three directions, yielding fragments similar to figure 21; cleavage lines not always distinct; brittle.

Smithsonite

Yellow, yellowish-brown.

LUSTER: nonmetallic; resinous to sparkling; transparent to translucent to opaque.

STREAK: brown to yellowish to whitish.

CLEAVAGE: perfect in six directions, yielding fragments similar to figure 28.

NOTE: may fluoresce in ultraviolet light.

Sphalerite

Yellow, greenish-yellow.

LUSTER: nonmetallic; resinous to sparkling; transparent to translucent to opaque.

STREAK: colorless, white, possible slight reddish tint.

HARDNESS: 5– $5\frac{1}{2}$, can be scratched by a steel file, possibly by a knife blade. Medium weight.

CLEAVAGE: two directions, parallel to base and side.

Sphene

Yellow, reddish-yellow.

LUSTER: nonmetallic; glassy, sparkling; transparent to translucent, may be opaque in dark colors.

STREAK: white.

HARDNESS: 8, will scratch quartz. Medium weight.

YELLOW

FRACTURE: shell-like; brittle.

Spinel

Yellow, yellowish-green.

LUSTER: nonmetallic; glassy to pearly on cleavage surface; transparent to translucent.

STREAK: colorless to white.

HARDNESS: $6\frac{1}{2}$ -7, can be scratched by quartz. Medium weight.

CLEAVAGE: perfect parallel to base and side, with cleavage lines meeting at an angle of near 90° ; brittle.

NOTE: a crystal may show different colors when held to a light and turned. May fluoresce in ultraviolet light.

Spodumene

Yellowish-brown.

LUSTER: nonmetallic; resinous to dull glassy; translucent to opaque, occasionally transparent.

STREAK: colorless to light gray.

HARDNESS: 7- $7\frac{1}{2}$, will scratch quartz. Medium weight.

FRACTURE: shell-like, rough; brittle.

NOTE: a small piece will appear blood-red or orange when held to a light.

Staurolite

Yellow, yellowish-brown.

LUSTER: nonmetallic; glassy; pearly on cleavage surface; translucent, occasionally transparent.

STREAK: colorless.

HARDNESS: $3\frac{1}{2}$ -4, can be scratched by a knife blade. Light weight.

CLEAVAGE: parallel to length.

Stilbite

Yellow, greenish-yellow, brownish-yellow, grayish-yellow, reddish-yellow

LUSTER: nonmetallic; resinous; transparent to translucent.

STREAK: pale yellow to white.

HARDNESS: $1\frac{1}{2}$ – $2\frac{1}{2}$, can be scratched by the fingernail and easily cut with a knife. Light weight.

FRACTURE: shell-like to uneven; brittle.

NOTE: if a crystal is rubbed, it may generate enough electricity to pick up tiny bits of paper.

Sulphur

Brassy-yellow.

LUSTER: metallic; brilliant; opaque.

STREAK: gray to grayish-black.

HARDNESS: $1\frac{1}{2}$ –2, can be scratched by the fingernail. Heavy weight.

CLEAVAGE: parallel to side of crystal.

NOTE: a small piece will melt in a candle flame.

Sylvanite

Brownish-yellow, orange-yellow.

LUSTER: nonmetallic; glassy, resinous, greasy; transparent to translucent to opaque.

STREAK: brown to black in thorite, orange-yellow in orange-ite.

HARDNESS: $4\frac{1}{2}$ –5, can be scratched by a knife blade. Heavy weight.

FRACTURE: shell-like.

NOTE: radioactive.

Thorite

Yellow, straw-yellow, wine-yellow, yellowish-brown.

LUSTER: nonmetallic; glassy; transparent, occasionally translucent.

STREAK: colorless.

HARDNESS: 8, will scratch quartz. Medium weight.

CLEAVAGE: perfect parallel to base; brittle.

NOTE: if a crystal is rubbed, it will generate enough electricity to pick up tiny bits of paper. May fluoresce in ultraviolet light.

Topaz

YELLOW

Yellow-green.

LUSTER: nonmetallic; glassy, pearly; transparent to translucent.

STREAK: paler green than color of mineral.

HARDNESS: 2-2½, can be scratched by a copper coin, possibly by the fingernail. Medium weight.

CLEAVAGE: parallel to base, separating into thin sheets.

NOTE: radioactive; may fluoresce in ultraviolet light.

Torbernite

Yellow.

LUSTER: nonmetallic; glassy to resinous; transparent to translucent to opaque.

STREAK: colorless.

HARDNESS: 7-7½, will scratch quartz. Medium weight.

FRACTURE: shell-like to uneven; brittle.

NOTE: a crystal will show different colors when held to a light and turned. May fluoresce in ultraviolet light.

Tourmaline

Straw-yellow, yellowish-brown.

LUSTER: nonmetallic; resinous to sparkling; translucent to opaque, occasionally transparent.

STREAK: colorless to yellowish or white.

HARDNESS: 3, can be scratched by a copper coin. Heavy weight.

FRACTURE: rough, uneven; brittle.

Vanadinite

Yellow.

LUSTER: nonmetallic; glassy; silky when fibrous; pearly on cleavage surface; faintly transparent to translucent.

STREAK: colorless to whitish to grayish.

HARDNESS: 4½-5, can be scratched by a knife blade. Medium weight.

CLEAVAGE: parallel to front and base; brittle.

NOTE: may fluoresce in ultraviolet light.

Wollastonite

Yellowish.

LUSTER: nonmetallic; diamond-like sparkle; translucent to opaque, occasionally transparent.

STREAK: colorless.

HARDNESS: $7\frac{1}{2}$, will scratch quartz. Heavy weight.

FRACTURE: shell-like; brittle.

Zircon

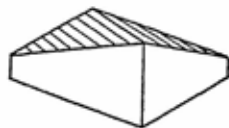
5 - Illustrations of Mineral Crystals and Fragments



1



2



3



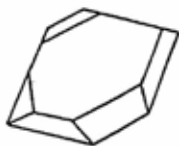
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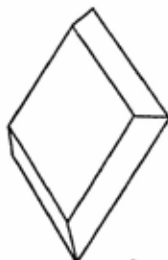
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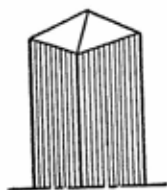


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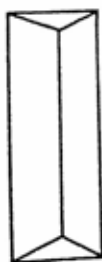
ILLUSTRATIONS OF MINERAL CRYSTALS AND FRAGMENTS



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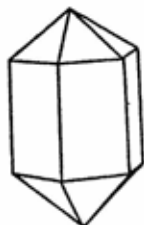
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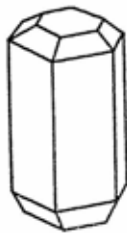
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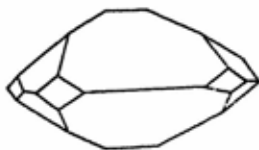
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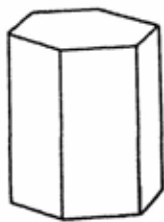
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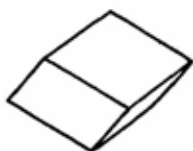
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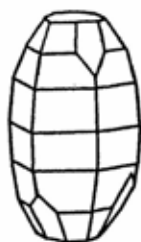
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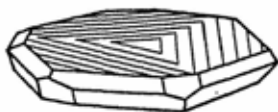
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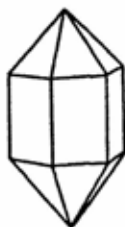
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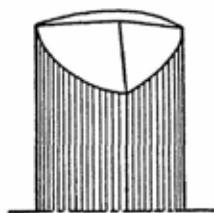


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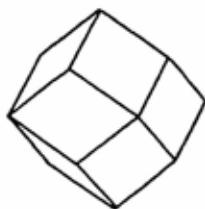


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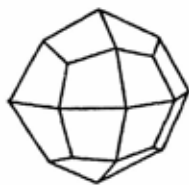
ILLUSTRATIONS OF MINERAL CRYSTALS AND FRAGMENTS



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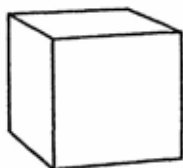
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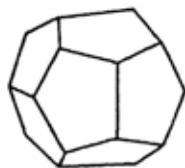
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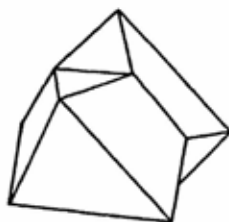
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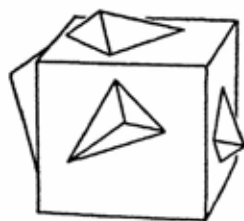
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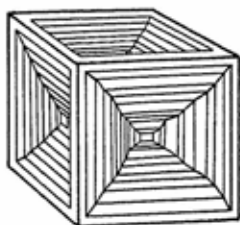
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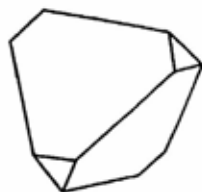
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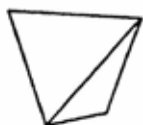
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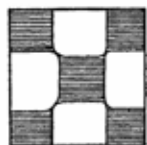
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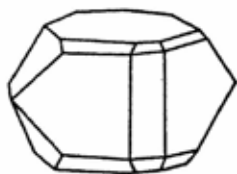
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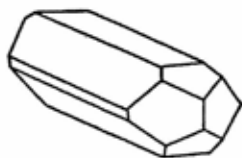


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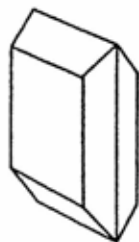
ILLUSTRATIONS OF MINERAL CRYSTALS AND FRAGMENTS



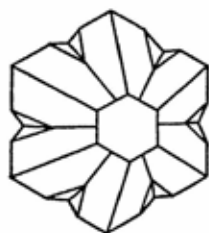
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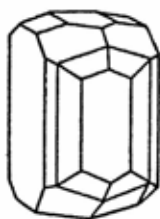
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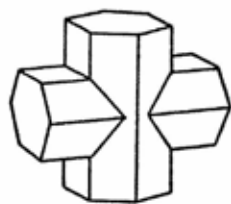
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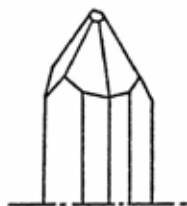
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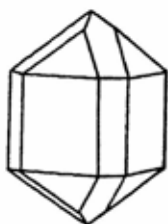
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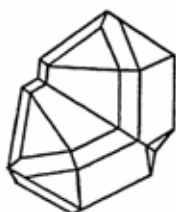
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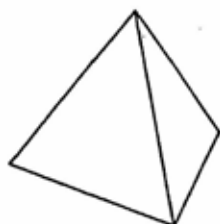
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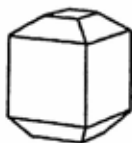
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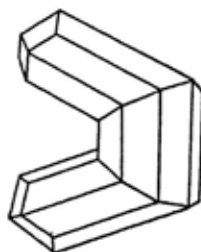
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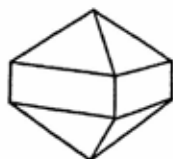
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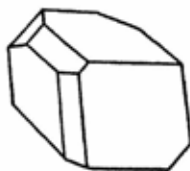
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6 - Description and Uses of Minerals

Actinolite A common rock-forming mineral.

COLOR: very light to dark green.

CRYSTALS are generally long and slender, similar to figure 1, or small, needle-like, and fibrous. Usually found as individual crystals or in groups of crystals, sometimes radiating like the spokes of a wheel.

OCCURS commonly in crystalline schists, frequently as the principal mineral; also in contact deposits with garnet, epidote, and molybdenite, and with tremolite and hornblende.

NEPHRITE is a tough, compact, fibrous variety of actinolite-tremolite closely resembling jadeite. It is dark green, sometimes with a tan coating, and occurs in veins in serpentine, and as pebbles and boulders in stream beds and on beaches. Gold particles are occasionally found with nephrite.

Albite A common rock-forming mineral used in the manufacture of ceramics; may fluoresce in ultraviolet light.

COLOR: colorless, white, gray, greenish, yellowish, reddish, bluish.

CRYSTALS are long, rather flat rectangles, usually so crowded together that they form masses of parallel plates without visible crystal faces; also found as grains.

OCCURS as grains in diorite, granite, and rhyolite; as grains, crystals, and small veins in crystalline schists, gneisses, serpentines, and pegmatites.

CLEAVELANDITE is a white, platy variety of albite usually found in pegmatites.

MOONSTONE is a variety of albite showing milky or bluish-white opalescence, and may be faintly fluorescent. Some

moonstones having a bluish-white opalescence are orthoclase.

Allanite A slightly radioactive rare-earth mineral.

COLOR: pitch-black, brownish-black, brown.

CRYSTALS are often flattened and rectangular, similar to figures 2 and 4; generally found in rock-like masses without visible crystal faces, and as embedded grains.

OCCURS as crystals and grains in granite, syenite, diorite, pegmatite, and gneiss; occasionally as masses in limestones and quartz veins.

Amblygonite A source of lithium which, when alloyed with aluminum, is used as a high-heat-resistant metal in supersonic aircraft. Lithium is also used in pharmaceutical products and glass making.

COLOR: pale blue, gray-blue, pale green, gray-green, white. CRYSTALS are more or less rectangular, with four near-equal faces meeting at oblique angles; generally found as coarse rock-like masses without visible crystal faces.

OCCURS almost exclusively in pegmatites with tourmaline, spodumene, lepidolite, and apatite. Amblygonite is not a common mineral.

Analcite (Analcime) A rock-forming mineral.

COLOR: colorless, greenish, reddish, white.

CRYSTALS usually have 24 equal faces, similar to figure 29; occasionally occurs in six-faced cubes with beveled corners. Also found in rock-like granular or compact masses without visible crystal faces. When rubbed or slightly heated, the crystals may generate enough electricity to pick up tiny bits of paper.

OCCURS as free-growing crystals, or in masses, in the cavities and seams of volcanic rocks, particularly basalt, and in pegmatites; occasionally found in placer deposits.

Andalusite A basic composition of aluminum and silicon used principally in the manufacture of porcelain for spark plugs; occasionally used as a gem stone.

COLOR: brown, reddish-brown, gray, olive green, colorless, rose-red, pink, white.

CRYSTALS are usually coarse and rough, four-sided, and nearly square. Generally found as individual crystals, or groups of crystals in pencil-like columns, or as compact rock-like masses without visible crystal faces. Some andalusite crystals will show red in one direction and green in another when held to a light and turned.

OCCURS most commonly in crystalline schists and gneisses with kyanite, sillimanite, staurolite, and lazulite, or embedded in muscovite, to which it eventually alters. Occasionally found with ilmenite and rutile, or as a deposit carrying small amounts of corundum and other minerals. Pink andalusite crystals are ordinarily found in pegmatites. Andalusite is formed by the alteration of shales and slates into crystalline schists, the weathering of which will leave the crystals exposed.

CHIASTOLITE is a variety of andalusite having a dark colored cruciform design appearing in the cross section of the crystal, similar to figure 40. It is generally found in slate.

Anglesite An ore of lead; may fluoresce in ultraviolet light.
COLOR: pale brown, greenish, colorless, gray, pale yellow, white.

CRYSTALS are usually transparent and colorless, and resemble two short pyramids placed base-to-base with flattened tops and bottoms, similar to figure 42; also found in granular to compact rock-like masses without visible crystal faces.

OCCURS principally in limestone, frequently in circular layers around a center of galena, from which it was formed. Usually found near the surface of lead deposits with cerussite, smithsonite, and sphalerite; also, to some extent, with azurite and gold ores.

Anhydrite Composed of a calcium-sulphur, combination, and used in the manufacture of paints, phonograph records, buttons, etc.

COLOR: pale blue, pale red, colorless, white, gray.

CRYSTALS are rare, resembling two short, thick pyramids placed base-to-base with flattened top and bottom. Found principally as crystalline rock-like masses, and in layered or granular masses.

OCCURS usually in beds with rock salt, or in cavities in limestone and basalt. Anhydrite frequently alters to gypsum, and occurs with that mineral in association with halite, pyrite, quartz, and calcite. It is heavier than calcite, and harder than gypsum.

Apatite Chief source of phosphorus, used principally in the manufacture of fertilizers. The transparent variety is sometimes used as a gem stone. May fluoresce in ultraviolet light.

COLOR: blue, pink, yellow, green, brown, colorless, violet, white.

CRYSTALS are six-sided, usually long with pyramid ends, or with the ends flattened, similar to figures 16 and 17. The color is frequently patchy, giving a melted appearance, and the transparent crystals are generally small. Also found in granular to compact rock-like masses without visible crystal faces, fibrous, and in small grains.

OCCURS as small crystals and grains in all kinds of rocks, and as large crystals in pegmatites associated with andalusite and dumortierite, and in deposits with sphene or magnetite. Also found as rock-like masses in shale, and as masses and small crystals in crystalline calcite. Apatite is very often confused with other minerals.

Aragonite A basic composition of calcium and carbon, closely related to calcite. May fluoresce in ultraviolet light.

COLOR: brown, colorless, white, yellow, gray, green, violet.

CRYSTALS are commonly long and slender with pointed ends, similar to figure 41; or short and flat-sided with dulled ends. Usually found in groups of crystals radiating like the spokes of a wheel, or branching with a coral-like form and appearance. Aragonite is also found in pencil-like columns, in kidney-shaped masses without visible crystal faces, and as stalactites.

OCCURS as crusts near hot springs; as needle-like crystals coating fracture surfaces of serpentine, chromite, and basalt; as crystalline masses in limestones; with gypsum; and as coral-like branches in iron ore deposits. Aragonite is also the pearly and iridescent surfaces on the inside of most sea shells.

Argentite A valuable ore of silver.

COLOR: black, dark lead-gray.

CRYSTALS are similar to figures 30 and 31, but are usually distorted into slender lattice-like or branch-like arrangements. Found principally in rock-like masses without visible crystal faces, and as coatings on other minerals.

OCCURS usually as veins in limestone, schist, granite, and gold-quartz; in veins with native silver, sphalerite, galena, and tetrahedrite; and in varying amounts in nickel and cobalt ores.

Arsenopyrite A source of arsenic, used in medicines, glass making, insecticides, etc.; occasionally contains cobalt or nickel, frequently contains gold.

COLOR: steel-gray, silver-white.

CRYSTALS are usually small and diamond-shaped, with flattened side angles and ribbed or grooved faces, similar to figure 3. Most commonly found in granular or compact rock-like forms without visible crystal faces.

OCCURS in crystalline limestone, frequently in gold-bearing quartz veins, and to some extent in pegmatites. Also occurs with silver ores, and chalcopyrite, pyrite, scheelite, wolframite, cassiterite, pyrrhotite, sphalerite, and galena.

DANAITE is cobalt-bearing arsenopyrite.

Augite A common rock-forming mineral of aluminous composition.

COLOR: black, dark green.

CRYSTALS are usually stubby and have eight vertical faces meeting at oblique angles, or long and thin; similar to

figures 5 and 6. Often found in coarse to fine granular or layered masses.

OCCURS commonly in andesite, diorite, gabbro, basalt, and peridotite; occasionally in gneiss and syenite. Rarely found in rocks containing quartz. Associated with olivine, orthoclase, magnetite, and hornblende.

Autunite An ore of uranium. Radioactive; highly fluorescent in ultraviolet light.

COLOR: apple-green, lemon-yellow, sulphur-yellow.

CRYSTALS are either square or rectangular, sometimes with beveled corners, but generally thin and plate-like. Also in plate-like structures, like mica, and as flakes and crusts.

OCCURS in flakes or scales as a coating on other uranium minerals; in pegmatites, clays, and in some limestones and black shales. Also found in light colored sandstones, usually those having streaks or layers of a darker color, and in varying amounts in veins of silver, lead, copper, and gold ores. The apple-green autunite could be mistaken for some of the green copper ores. As an alteration product of pitchblende, autunite may be a surface guide to that mineral.

Axinite A possible gem stone; may fluoresce in ultraviolet light.

COLOR: plum-blue, violet, lavender, purple, yellow, pink, gray, greenish, clove-brown, white.

CRYSTALS are commonly wedge shaped, frequently thin with sharp edges, similar to figure 61. Also found in groups of flattened crystals resembling knife blades, and occasionally in granular rock-like masses without visible crystal faces.

OCCURS in cavities in granites, serpentines, and pegmatites; in veins in limestones; and sometimes in placer deposits with gold. Found with epidote, smithsonite, wollastonite, sphene, quartz, prehnite, and zoisite.

Azurite An ore of copper; also a possible gem or ornamental stone.

COLOR: rich deep blue.

CRYSTALS are usually rectangular, small and well-formed, occasionally ribbed, similar to figure 7. Also found as tiny crystal coatings, or in groups of crystals radiating like the spokes of a wheel, or in rock-like or earthy forms without visible crystal faces.

OCCURS generally in the upper portions of copper veins, particularly those located in limestone, associated with malachite, cuprite, native copper, and chrysocolla; also found in varying amounts with arsenopyrite, anglesite, chalcopyrite, silver and gold ores, and occasionally with ores of uranium and vanadium.

Barite A source of barium, used generally as a paint pigment, and in the manufacture of textiles. In California it is used principally to add weight to oil well drilling mud. May fluoresce in ultraviolet light.

COLOR: blue, yellow, red, colorless, white, gray.

CRYSTALS are common; they are rather flat, usually diamond shaped or rectangular with beveled edges or corners, similar to figures 43 and 44. Also found in groups of coarse flat plates forming "barite roses," or in granular or layered masses.

OCCURS commonly as a minor mineral in veins with gold, silver, copper, cobalt, and lead ores. Also occurs as veins, sometimes crystalline, in schists, slates, basalts, and limestones. Crystals are occasionally found in thin layers in serpentine.

Bauxite Chief ore of aluminum. May fluoresce in ultraviolet light.

COLOR: brown, white, gray, yellowish, reddish.

CRYSTALS: none. Found in clay-like masses, earthy, or as pea-sized or rounded grains embedded in rock-like clayish masses.

OCCURS as a result of the decomposition of syenite or the weathering of dolomitic limestone, usually in tropical to subtropical climates.

Benitoite Transparent variety is an unusual gem stone, difficult to distinguish from sapphire in appearance. May fluoresce in ultraviolet light.

COLOR: blue, blue-green, green, colorless.

CRYSTALS are semi-triangular, six-sided, rather flat, similar to figure 18; also found in grains.

OCCURS embedded in natrolite in serpentine, principally in San Benito County, California.

Beryl A valuable gem stone; also the principal source of beryllium, a rather rare corrosion-resistant metal similar to aluminum.

COLOR: blue-green, colorless, white, pink to deep rose-red, clear golden yellow, deep or emerald green.

CRYSTALS are very distinct and well formed, six-sided, rough faced, similar to figure 19. Often with vertical ribbing or grooves, and occasionally a frosted or mottled appearance. Crystals vary in size from small to very large.

OCCURS as crystals in small veins in granite rocks, in pegmatites, and in mica schists. Beryl is a rather widespread mineral, occurring with topaz, tourmaline, garnet, rutile, cassiterite, chrysoberyl, and occasionally with fluorite. In some instances beryl crystals, particularly the pink variety, have been found in placer deposits.

EMERALD is a valuable gem stone of deep green, transparent beryl, and is generally found in pegmatites.

AQUAMARINE is a transparent gem stone of blue, blue-green, or green.

MORGANITE is beryl of deep rose-red to pink, and is used as a gem stone.

GOLDEN BERYL is a gem stone of clear golden yellow.

Biotite Mica, a common rock-forming mineral, occasionally used as an insulating material.

COLOR: black, dark brown, dark green.

CRYSTALS are rare; usually found in six-sided plates or scales.

OCCURS as scales in most rocks, particularly granite and syenite; in schists and gneisses; and occasionally as large sheets in pegmatites.

Borax Used in the manufacture of cleaning agents, medicines, etc. Borax is also a source of boron, which is used in high-energy fuels for jets, rockets, and missiles.

COLOR: colorless, grayish, white.

CRYSTALS are more or less rectangular and box-like. Generally found in porous masses, powders, or crusts.

OCCURS as a result of moisture evaporation. Large thick layers of borax occur in many places in Death Valley, California, and in smaller amounts around dry lake beds in Nevada.

Bornite A valuable ore of copper, containing varying amounts of iron. Some varieties contain sufficient silver to be a valuable source of that metal. Often called *peacock ore* because of the iridescence of the tarnish.

COLOR: reddish-brown to brownish-bronze on fresh fracture; purple tarnish on exposure to the air.

CRYSTALS are rare; occasionally cube shaped and rough, possibly having eight triangular faces, or twelve faces meeting at oblique angles. Usually found in grains, or in granular to compact rock-like masses without visible crystal faces.

OCCURS in grains, flakes, or small veins scattered in syenites, diorites, pegmatites, schists, and occasionally in serpentines and with ores of uranium and vanadium. Also found in varying amounts with magnetite, chalcopyrite, free gold, tetrahedrite, chalcocite, and molybdenite.

Calaverite An ore of gold and tellurium, an element used as a corrosion resistant in lead, and to increase the strength of rubber; generally contains silver.

COLOR: steel-gray, silver-white, brass-yellow.

CRYSTALS are long and slender, lath-like, with deeply grooved faces. Ordinarily found in granular rock-like masses without visible crystal faces.

OCCURS usually in veins in areas where granite is plentiful, and with sylvanite and quartz.

Calcite A very common mineral, and a source of calcium, used principally in the manufacture of cement. Will frequently fluoresce in ultraviolet light.

CARNOTITE

THE ROCK-HUNTER'S FIELD MANUAL

COLOR: black, blue, brown, colorless, gray, green, red, white, yellow.

CRYSTALS are commonly found in forms similar to figures 20, 21, and 22, although any number of variations are possible. Found generally as crystals, but other forms are also common: granular, earthy, chalky, stalactitic, and in fine to coarse grained or compact masses without visible crystal faces.

OCCURS abundantly as a minor mineral in veins with lead, silver, and copper ores; with cinnabar, scheelite, idocrase, fluorite, and quartz. Also occurs in clay-shale and basalt, in caves, and near spring waters.

ICELAND SPAR is a colorless and transparent variety of calcite having the property of strong double refraction—that is, a single line will appear double when viewed through a crystal. It is used in optical prisms.

Carnotite An ore of uranium and vanadium, and a source of radium. Highly radioactive; may be fluorescent in ultraviolet light.

COLOR: greenish-yellow, chrome-yellow, lemon-yellow, canary-yellow.

CRYSTALS are microscopic and rare; usually found as earthy masses or thin earthy coatings, occasionally crystalline or as a powder.

OCCURS generally in light colored sandstones, usually those having streaks or layers of a darker color; also in or near some petrified woods. Carnotite is not a common mineral, and to date has been found principally in the high plateau region of Utah, Colorado, Arizona, and New Mexico.

Cassiterite (Tin Stone) The major source of tin; occasionally used as a gem stone.

COLOR: black, yellow, white, gray, brown, reddish.

CRYSTALS are similar to figure 54; frequently two crystals are intergrown in an elbow shape similar to figure 55. Usually found in rock-like masses without visible crystal faces, or in grains; also in rounded or angular grains or pebbles in stream beds (stream tin).

OCCURS generally in veins in quartz areas and in or near granite, and possibly containing such minerals as tourmaline, columbite, apatite, topaz, fluorite, and wolframite. Also found in small amounts in pegmatites; as crystals in diorite, quartzite, and limestone; and as scattered grains in granite. To separate the grains of cassiterite from the granite rock, it is necessary to crush the rock then wash it in the same manner that gold is panned. This panning method is also used for stream tin.

Celestite A source of strontium, used in the manufacture of tracer bullets, fireworks, etc. May fluoresce in ultraviolet light.

COLOR: light blue, light red, white, colorless.

CRYSTALS are usually long and rather flat, or slightly rounded, showing four faces on the ends, similar to figures 45 and 46. Also found as masses of small fibers radiating like the spokes of a wheel, and as granular masses.

OCCURS generally in limestone or sandstone, and with borax, colemanite, gypsum, dolomite, fluorite, sulphur, and calcite.

Cerussite An important ore of lead.

COLOR: brownish, colorless, white, gray.

CRYSTALS are flattened rectangular plates, similar to figure 47, usually in groups having a hollow network appearance. Generally found as granular rock-like masses without visible crystal faces; occasionally as masses of fibers.

OCCURS as an alteration product of galena, and often found surrounding a core of that mineral. Found primarily with galena, silver-bearing galena, and sphalerite; also with chrysocolla, anglesite, limonite, smithsonite, tetrahedrite, and vanadinite.

Chalcedony A variety of quartz used as gem or ornamental stones.

COLOR: black, blue, gray, brown, red, white, green, yellow.

CRYSTALS are so tiny that they cannot be seen even under a microscope.

OCCURS in banded layers or masses in granite, rhyolite, pegmatite, serpentine, gneiss, and schist. Also found lining cavities or cracks in volcanic rocks where it sometimes forms geodes; and in stream beds and river sands.

CARNELIAN is deep red, orange-red, reddish-white; transparent to near-opaque; fibrous.

SARD is orange-red, reddish-brown, brown; translucent; darker in color than carnelian.

ONYX is in straight parallel bands of alternating colors, usually white and black, or white and brown; also white and red, gray, and pale blue; translucent. Used principally in making cameos.

SARDONYX is onyx with layers of reddish-brown sard alternating with black or white.

CHRYSOPTASE is apple green to yellowish-green; transparent to translucent; could be confused with jadeite.

PTSAZULITE is dull leek green; translucent. Often occurs with jasper.

JASPER is red or reddish-brown; translucent to opaque.

BLOODSTONE is dark green with reddish-brown spots of jasper scattered through it; translucent.

AGATE is usually in circular or curving bands of red, white, brown, gray, or pale blue; translucent. May fluoresce in ultraviolet light.

MOSS AGATE is white to gray, possibly pale blue, with embedded mosslike or fernlike formations; transparent to translucent.

AGATIZED WOOD is wood that has been petrified with agate.

FLINT is gray to brown or black; dull luster; nearly opaque. Leaves sharp edges on fracture.

Chalcocite An important ore of copper; some varieties contain sufficient silver to be a valuable source of that metal.

COLOR: black, gray-black, lead-gray.

CRYSTALS are small, six-sided, deeply grooved; rare. Usually found as fine grained or compact rock-like masses without visible crystal faces; also in a soft near-powder form that is almost like soot.

OCCURS as small veins in serpentines, granites, and schists;

with chalcopyrite, cuprite, and bornite; occasionally with tetrahedrite, magnetite, and ores of uranium and vanadium. Chalcocite is sometimes spotted with green malachite.

Chalcopyrite An important and widespread ore of copper, possibly containing enough gold or silver to be mined for those metals.

COLOR: brass yellow.

CRYSTALS are usually wedge-shaped, triangular, similar to figure 56. Generally found in rock-like masses without visible crystal faces, or as tiny specks or flakes.

OCCURS as veins in quartz and serpentine, and as crystals, flakes, or masses in most igneous rocks, pegmatites, and contact deposits. Also occurs in veins of gold-quartz, and with pyrrhotite, galena, pyrite, sphalerite, marcasite, garnet, axinite, epidote, and occasionally with ores of uranium and vanadium. Chalcopyrite, like pyrite, is called "fool's gold" because of its color; however, chalcopyrite is softer than pyrite and more brittle than gold.

Chlorite A common mineral resembling mica, basically composed of aluminum, iron, and magnesium.

COLOR: green, yellow, white, rose-red, violet.

CRYSTALS are thin, six-sided, rarely distinct. Usually found as rock-like masses of six-sided plates or tiny scales.

OCCURS in schists where the entire composition may be chlorite, slates, limestones, and serpentines, with chromite, garnet, tourmaline, and idocrase.

Chromite The only ore of chromium. May be slightly magnetic.

COLOR: iron-black, brown-black.

CRYSTALS are similar to figure 30, but are small and rare.

Usually found in granular to compact rock-like masses, sometimes huge, without visible crystal faces, or as grains.

OCCURS as veins and masses in serpentine, occasionally coated with tiny crystals of garnet, and in placer deposits in serpentine areas.

Chrysoberyl A valuable gem stone; also a minor source of beryllium, a rather rare corrosion-resistant metal similar to aluminum.

COLOR: brown, brownish-green, emerald green, yellowish-green, yellow, grayish-green.

CRYSTALS are usually rather flat and wedge shaped with vertical grooves on the faces; generally found in groups of crystals grown together forming a thin six-sided plate with sharp points, similar to figure 48.

OCCURS principally as crystals in pegmatites, occasionally in mica schists, or in stream and river beds. It is not a common mineral.

ALEXANDRITE is a valuable gem stone having an emerald green or grayish-green color by daylight, and a red color in artificial light.

CAT'S EYE is a valuable gem stone which, when cut, shows a narrow beam of light that changes position as the stone is turned; also shows an opalescent play of colors.

Chrysocolla A minor ore of copper sometimes resembling turquoise and often used as an ornamental stone.

COLOR: black, green, greenish-blue, sky-blue.

CRYSTALS are so fine that they cannot be seen even under a microscope, but give an over-all enamel-like appearance. Usually found in rock-like masses, earthy crusts, grains, or as opal-like coatings.

OCCURS principally in the upper portions of copper veins lying in limestone, with azurite, malachite, native copper, and cuprite; also found in varying amounts in gold-quartz veins and in serpentine. Chrysocolla is softer than turquoise, and if touched to the tongue, will often stick to it.

Cinnabar The only important ore of mercury (quicksilver).

COLOR: scarlet to dark red, bright red, reddish-brown.

CRYSTALS are usually small, having six similar faces meeting at oblique angles. Generally found as fine granular rock-like masses without visible crystal faces; also as earthy masses, crusts, and vein fillings.

OCCURS principally in areas where serpentine is more or less surrounded by sandstone or shale, or in clay-like sandstone; also occurs as small crystals in rhyolite, and as grains or crusts in gold-quartz veins. Occasionally found with gold in placer deposits, and with calcite, stibnite, barite, and quartz.

Cobaltite An ore of cobalt, used in the manufacture of steel for surgical instruments, etc. Cobaltite generally contains some iron and nickel.

COLOR: gray, silver-white, white with reddish tint.

CRYSTALS usually have six equal square faces, or twelve faces each of which has five angles or corners, similar to figures 31 and 32; deeply grooved. Also found as granular rock-like masses without visible crystal faces.

OCCURS as grains or small veins in schists, usually with chalcopryrite; in varying amounts in gold and silver ores; occasionally with ores of uranium and vanadium. Also found with arsenopyrite, pentlandite, and calcite.

Colemanite A source of borax, used in the manufacture of cleaning agents, medicines, etc., and of boron, used in high-energy fuels for jet and rocket engines. May fluoresce in ultraviolet light.

COLOR: colorless, white.

CRYSTALS are usually short, four-sided, brilliant, transparent. Also found as granular to compact rock-like masses without visible crystal faces, and as crusts.

OCCURS as layered deposits and seams in dry lake beds, particularly in the desert regions of California and Nevada. Also found with kernite, borax, and celestite.

Columbite (Tantalite) Columbite contains the rare element columbium, which is used as a corrosion-resistant factor in stainless steel. Tantalite contains tantalum, which is used in the manufacture of chemical equipment and surgical instruments. Columbite can be distinguished from tantalite only by chemical tests.

COLOR: iron-black, brownish-black, reddish-brown, gray.
CRYSTALS are short and nearly square, similar to figure 49, or thin and rectangular. Also found in rock-like masses without visible crystal faces.
OCCURS in or near granite, principally in pegmatites, with cassiterite, quartz, garnet, lepidolite, tourmaline, beryl, orthoclase, and monazite.

Copper Native copper, frequently contains small amounts of silver.

COLOR: copper-brown, copper-red.
CRYSTALS are generally malformed and indistinct, appearing as groups in wire-like or branch-like formations. Also found as scales, grains, thin sheets, and irregularly shaped lumps.
OCCURS in varying amounts with cuprite, chalcopyrite, malachite, and pyrite; also to some extent in serpentine, gold-quartz, and quartz veins, and in some slates and sandstones. Occasionally found as grains or scales in placer deposits, and with limonite and rhodonite.

Cordierite (Iolite) Transparent variety is sometimes used as a gem stone; basically composed of aluminum, iron, magnesium, and silicon.

COLOR: various shades of blue, whitish-gray, purple.
CRYSTALS are usually grown together, appearing six-sided; some crystals will show various colors when held to a light and turned. Found principally as grains or in rock-like masses without visible crystal faces; closely resembles quartz.
OCCURS primarily in schists and gneisses with biotite, andalusite, quartz, and orthoclase; also in pegmatites; and possibly as scattered grains in granite. Knots of blue cordierite may form in slates around a contact zone.

Corundum Used as gem stones when transparent, or abrasives when opaque. May fluoresce in ultraviolet light.

COLOR: black, blue, gray, purple, pink, red, green, yellow, brown, white, colorless.

CRYSTALS are coarse and thick, six-sided, barrel-shaped, or flattened, similar to figures 23 and 62. Found also in coarse to fine granular or compact rock-like masses without visible crystal faces, or as pebbles.

OCCURS in crystalline limestone, mica schist, gneiss, pegmatite, syenite, dunite, and in or near peridotite; occasionally in clay resulting from the disintegration of basalt. Also occurs as pebbles in stream beds, gravels, and clays, and with andalusite, dumortierite, garnet, magnetite, spinel, olivine, and serpentine. The thick barrel-shaped crystals are more commonly found in syenite.

EMERY is black granular corundum mixed with magnetite. The two minerals can be separated by first powdering, then using a magnet to withdraw the grains of magnetite. The transparent blue corundum is the gem stone *sapphire*, and red corundum is the *ruby*. Other gem corundum is named after other gems using the prefix "oriental," thus oriental amethyst is purple corundum, oriental topaz is yellow, and oriental emerald is green.

Covellite An ore of copper.

COLOR: indigo blue.

CRYSTALS are six-sided, rather flat; rare. Found generally in platy or rock-like masses without visible crystal faces, or as coatings or grains.

OCCURS with other copper minerals, principally chalcopyrite, bornite, and chalcocite; also with sphalerite, galena, and gold. Covellite is not a common mineral.

Cuprite An important ore of copper.

COLOR: reddish-brown, ruby red, reddish-gray.

CRYSTALS are variable: small cubes having six equal faces; like two pyramids placed base-to-base and having eight triangular faces; or a combination of both—similar to figures 31, 30, and 36; or very slender and needle-like. Transparent crystals are ruby red. Found principally in rock-like masses.

OCCURS as veins usually near the surface of copper deposits with chalcopyrite, chrysocolla, native copper, malachite, and azurite.

Diamond Used as gem stones and in industry. May fluoresce in ultraviolet light.

COLOR: black, gray, white, colorless, yellow, red, green, blue, brown.

CRYSTALS have eight triangular faces, but are generally slightly round with curved faces, or two crystals are grown together. Similar to figures 30, 33, and 34. Sometimes the crystals are completely round, like peas. If a diamond crystal is rubbed, it may generate enough electricity to pick up tiny bits of paper.

OCCURS principally as isolated crystals in the sand and gravel of stream beds, usually in the vicinity of serpentine or peridotite. Also found in a type of peridotite known as "kimberlite," which is rather soft and yellow on the surface, and blue underneath.

During the gold-rush days of California, several diamonds were reported found with gold in creek beds and river sands, and many stones have been found in placer deposits since that time. However, Arkansas is the only state in which diamonds have been mined.

Diopside A common rock-forming mineral having a basic composition of calcium and magnesium; possibly used as a gem stone when transparent.

COLOR: colorless, green, white, gray, purple.

CRYSTALS are four- or eight-sided, and rectangular. Found in groups of crystals in pencil-like columns, or as granular rock-like masses without visible crystal faces.

OCCURS in crystalline limestones with idocrase, sphene, axinite, garnet, and occasionally tourmaline. Also occurs in serpentines, peridotites, gabbros, and some schists.

Dolomite A source of magnesium, a metallic element that is combined with oxygen to make a high-heat-resistant

ceramic material used in missiles and jet aircraft; also used in the manufacture of magnesium flares and refractory bricks. Dolomite makes excellent ornamental or building stones; it frequently contains manganese, occasionally contains gold.

COLOR: black, brown, colorless, white, flesh-pink, green, gray.

CRYSTALS have six faces, usually curved, similar to figure 24.

Found as groups of curved crystals in a saddle shape, or as coarse to fine granular or compact rock-like masses without visible crystal faces.

OCCURS principally as rocks of limestone and marble. Also as white gold-carrying veins in serpentine, or in veins crossing limestone, usually with galena, cerussite, anglesite, and sphalerite.

Dumortierite A basic composition of aluminum, boron, and silicon, used in the manufacture of porcelain for spark plugs, etc.

COLOR: blue, greenish-blue, pink, red, violet.

CRYSTALS are small and rectangular; rare. Usually found as fibrous masses radiating like the spokes of a wheel, or in pencil-like columns; also in granular rock-like or boulder-like masses without visible crystal faces.

OCCURS usually in schists and gneisses, occasionally in pegmatites, some granites, and quartz; and with andalusite, kyanite, and sillimanite.

Epidote A common mineral having a basic composition of calcium, aluminum, iron, and silicon; sometimes used as a gem stone.

COLOR: green, blackish-green, yellowish-green, brownish-green.

CRYSTALS are usually long and rather flat with beveled edges, similar to figure 2, or slightly rounded with parallel grooves. Also found as groups of crystals in pencil-like columns; fibrous; and as coarse to fine granular or compact masses without visible crystal faces. A crystal will show green in

one direction and brown in another when held to a light and turned.

OCCURS in schists, usually with calcite; gneisses, crystalline limestones, pegmatites, and contact zones. Found with garnet, idocrase, quartz, molybdenite, scheelite, zircon, sphene, and pyrite.

Fluorite A basic composition of calcium and fluorine, used in making steel and colored glass; in the chemical industry, and to some extent in the optical industry. Occasionally used as a gem stone, but too soft to be used extensively in this line. Will generally fluoresce in ultraviolet light.

COLOR: blue, bluish-green, purple, green, yellow, brown, white, rose.

CRYSTALS are cubes having six square faces, similar to figure 31; in twin crystals where one cube penetrates another, they are similar to figure 35. Also found as groups of crystals in pencil-like columns, and in block-like formation, or in coarse to fine granular rock-like masses without visible crystal faces. Either in crystals or masses, fluorite may show bands of color.

OCCURS commonly in limestone and dolomite, occasionally in pegmatites. It is found in veins in quartzite and marble as the chief mineral; in veins with galena, silver, quartz, sphalerite, and cassiterite; and with calcite, barite, tourmaline and topaz. Fluorite, particularly the purple colored, is occasionally found with ores of uranium and vanadium.

Galena The chief ore of lead. Galena crystals are used in electronic tubes, and fine grained galena frequently contains sufficient silver to be a valuable source of that metal.

COLOR: blackish, lead-gray.

CRYSTALS are usually well-formed six-sided cubes similar to figure 31, sometimes having rounded corners; or a combination of forms resulting in eight triangular faces with diamond-shaped center faces, similar to figure 36. Also found in coarse to fine granular masses without visible crystal faces.

OCCURS in most igneous rocks, schists, and limestones, usually with gold and silver ores, and occasionally with ores of uranium and vanadium. Also found with sphalerite, fluorite, pyrite, chalcopyrite, and marcasite.

Garnet Used as gem stones, or abrasives.

COLOR: black, white, green, yellow, red, brown, colorless.

CRYSTALS are distinct and usually well-formed. Some are slightly rectangular and have 12 equal faces, and others are slightly round and have 24 equal faces; similar to figures 28 and 29. Also found as grains, or fine to coarse granular to compact masses without visible crystal faces.

OCCURS in crystalline limestones, gneisses, schists, quartzites, serpentines, diorites, and pegmatites, and as grains in river and beach sands, sometimes with gold. Also found with epidote, galena, chalcopyrite, quartz, tourmaline, scheelite, sphene, and zircon.

ALMANDITE is deep red to brownish-red, occasionally black, and is commonly found in gneisses, mica schists, and diorites.

ANDRADITE is yellow, green, brown, or black, and is found principally in schists and gneisses.

PYROPE is deep red to near-black, and is found in peridotite and serpentine.

GROSSULARITE is white, green, colorless, yellow, brown, or reddish, and is commonly found in crystalline limestone.

SPESSARTITE is red, reddish-brown to brown, and is usually found in pegmatites and rhyolites.

UVAROVITE is emerald green to dark green, and is found in serpentine and as crystals coating chromite.

Garnierite An ore of nickel.

COLOR: apple-green, greenish-white, white.

CRYSTALS are not known. Found as earthy masses or crusts.

OCCURS with serpentine and chromite as an alteration product of peridotites and dunites. Occasionally found with ores of uranium and vanadium.

GOLD

Gold Native gold, possibly containing small amounts of silver.

COLOR: pale to golden yellow.

CRYSTALS sometimes have eight triangular faces similar to figure 30, but are ordinarily malformed and irregular. Found principally in crystalline wire-like or branch-like forms resembling ferns; also as flakes, scales, grains, and nuggets.

OCCURS commonly with quartz or in quartz veins; also as flakes, grains, or nuggets with pyrite, arsenopyrite, chalcopyrite, calcite, fluorite, albite, talc, and barite; and occasionally with ores of uranium and vanadium. Gold is found in almost all kinds of rocks, and is particularly characteristic of milky white quartz. It is also found as nuggets or flakes in river and stream beds, and in black sea sands; in this form it is obtained by the "panning" method, wherein the heavier gold sinks to the bottom of the pan and the lighter particles are washed away. In the pan, gold will shine in the shade whereas other minerals will not. Chalcopyrite and pyrite, both called "fool's gold," are lighter in weight than gold, and are not malleable.

Graphite Native carbon, used in the manufacture of lubricants and lead pencils.

COLOR: black, steel-gray.

CRYSTALS are usually six-sided, rather flat. Commonly found in masses of plates, leaves, or scales; in pencil-like columns, earthy, granular or compact, without visible crystal faces. **OCCURS** principally in crystalline limestones, schists, and gneisses; in small amounts in granite; and occasionally with quartz, biotite, sphene, tourmaline, apatite, pyrite, and orthoclase.

Greenockite An ore of cadmium, used as an oxidation-resistant plating for supersonic aircraft parts, and in the manufacture of glass, porcelain, and paint.

COLOR: yellow, orange-yellow, orange, reddish.

CRYSTALS are roughly six-sided, flat based, tapering up to a

flattened tip; rare. Usually found as a thin coating or powder over other minerals.

OCCURS principally as a coating on sphalerite and other zinc ores, and on magnetite, quartz, and possibly calcite; occasionally found with hemimorphite. Greenockite is not a common mineral.

Gypsum A basic composition of calcium and sulphur used in making plaster of Paris, plaster, cement, and fertilizers. The varieties *alabaster* and *satin spar* are used for ornamental purposes.

COLOR: brown, gray, colorless, white, yellow, red.

CRYSTALS are rather flat and diamond shaped, having beveled edges, similar to figure 8; or rectangular with beveled corners, similar to figure 9. Frequently two diamond shaped crystals grow together forming a swallow-tail. Also found in fibrous form, in masses that can be separated into plates, in granular rock-like masses without visible crystal faces, and as sand.

OCCURS frequently as large beds between layers of limestone and shale, and in smaller amounts in sand and clay; also as worthless filler material in metallic ore veins. Gypsum is often an alteration product of anhydrite, and is found with that mineral; it is also found with celestite, halite, dolomite, quartz, calcite, and borax.

ALABASTER is usually white, and found in fine-grained rock-like masses.

SATIN SPAR is fibrous and silky looking. May fluoresce in ultraviolet light.

SELENITE is generally colorless and glassy, with cleavage parallel to the sides of the crystal, yielding thin transparent plates or sheets. It is used in the optical industry. May fluoresce in ultraviolet light.

Halite Ordinary salt, used in the chemical industry. May fluoresce in ultraviolet light.

COLOR: blue, yellow, purple, colorless, white, red.

CRYSTALS have six square faces, well formed, similar to

figure 31; some have hollowed-out faces resembling hoppers, similar to figure 37. Also found as crystalline rock-like masses (rock salt), or as crusts.

OCCURS commonly in dry lake beds in desert regions, and with gypsum, anhydrite, and calcite.

Hematite An important ore of iron, also used as a color pigment. May be slightly magnetic.

COLOR: black, red, reddish-brown, brown, steel-gray.

CRYSTALS are usually six-sided, thick or thin, flat surfaced, frequently with triangular markings on the top, similar to figure 25. Also found in red earthy masses without visible crystal faces (red ocher); in kidney-shaped masses or resembling bunches of grapes (kidney ore); or in shiny rock-like masses of crystalline flakes (specular hematite).

OCCURS as small grains to large masses in metamorphic rocks, and as small grains in most granites; also as the red color in sandstone where it acts as a binder material, or cement, for quartz grains. Specular hematite is sometimes found with andalusite or epidote; other varieties are generally found with magnetite.

Hemimorphite An ore of zinc. Will frequently fluoresce in ultraviolet light.

COLOR: bluish, white, colorless, greenish, brown.

CRYSTALS are rather thin rectangles to which pyramid bases have been added, similar to figure 50. Usually found in groups of crystals radiating from a central base; also in large rounded crystalline lumps, granular, and in rock-like masses without visible crystal faces.

OCCURS principally in the upper portions of zinc veins lying in limestone, with willemite, sphalerite, and smithsonite; and with chrysocolla, cerussite, anglesite, and galena.

Hornblende A rock-forming mineral basically composed of aluminum, iron, and silicon.

COLOR: black, dark green, brownish.

CRYSTALS are generally long and slender resembling knife blades, similar to figure 1; also found in groups of crystals in pencil-like columns, or in coarse to fine grained rock-like masses without visible crystal faces.

OCCURS commonly as a rock-forming mineral in syenite, granite, gabbro, andesite, schist, and gneiss.

Idocrase (Vesuvianite) A possible gem or ornamental stone having a basic composition of calcium, aluminum, and silicon, with some iron and magnesium.

COLOR: blue, white, green, yellowish-green, sulphur-yellow, brown.

CRYSTALS are short, thick, and square, with flattened pyramidal tops and bottoms, similar to figure 57. Found as crystals, or as groups of vertically grooved crystals in pencil-like columns; also as granular rock-like masses without visible crystal faces.

OCCURS principally in crystalline limestones and contact zones, with garnet, diopside, calcite, wollastonite, tourmaline, and epidote; also in serpentines, and chlorite schists.

CALIFORNITE is a variety of idocrase, yellowish-green to green, with white or grayish streaks; tough, compact; resembles jade. White californite resembles white garnet. Occurs as small veins or rounded lumps in serpentine, or as pebbles in stream beds.

Ilmenite A source of titanium, used in the manufacture of heat-resistant steel for supersonic aircraft, and as a paint pigment. May be magnetic.

COLOR: black.

CRYSTALS are generally thick and six-sided, with slightly rounded corners. Usually found as thin plates or compact rock-like masses, or as grains and pebbles.

OCCURS as grains in igneous rocks, and as masses and veins in metamorphic rocks, particularly gneisses. Ilmenite resembles magnetite, and is found frequently with that mineral; also with quartz, andalusite, epidote, and occasionally with allanite and monazite. Ilmenite also occurs as fine to

coarse black grains in river, stream, and beach sands with rutile, zircon, and magnetite grains.

Jadeite Used as gem and ornamental stones.

COLOR: gray, white, green, brown.

CRYSTALS have four vertical faces meeting at oblique angles; rare. Usually found in granular to compact rock-like masses without visible crystal faces, or in very tough fibrous masses.

OCCURS principally as pebbles or boulders in stream and river beds, or in serpentines; occasionally in schist.

Kaolinite The principal mineral in clay, having a basic composition of aluminum and silicon. It is used in the manufacture of china, brick, tile, ceramics, etc.

COLOR: brown, gray, white, yellow, red.

CRYSTALS are six-sided very thin plates, so small and close together that it is difficult to see them. Usually found as granular or compact claylike masses, or earthy.

OCCURS widespread in clay, principally as an alteration product of microcline or orthoclase, and as a result of the decomposition of rocks. Kaolinite has a strong clay odor when slightly dampened.

Kernite The major source of borax, used in the manufacture of cleaning agents, medicines etc., and of boron, which is used in high-energy fuels for jets, rockets and missiles.

COLOR: colorless, white.

CRYSTALS are generally not recognizable. Usually found in large beds or deposits.

OCCURS in old lake beds and clays. At the present time, kernite is found only in the Mojave Desert in Kern County, California.

Kyanite A basic composition of aluminum and silicon, used principally in the manufacture of high-grade porcelain; the transparent variety is occasionally used as a gem stone.

COLOR: blue, white, gray, green.

CRYSTALS are generally long and rather flat, resembling knife

blades, with indistinct end faces; usually darker in color toward the center, and possibly having a patchy appearance. Commonly found as individual crystals, or groups of crystals.

OCCURS in gneisses and schists, often with garnet, corundum, staurolite, andalusite, and dumortierite; also with quartz and black tourmaline.

Lazulite A possible gem stone having a basic composition of aluminum, magnesium, and iron.

COLOR: azure blue.

CRYSTALS resemble sharp pointed pyramids, or are wedge-shaped; good crystals are rare. Generally found in granular to compact rock-like masses without visible crystal faces.

OCCURS as masses and veins in quartzites and schists, with muscovite, corundum, rutile, andalusite, quartz, and kyanite. Lazulite is not a common mineral.

Lazurite (Lapis Lazuli) Used as an ornamental or gem stone, having a basic composition of sodium, aluminum, and silicon, with some sulphur.

COLOR: azure blue, greenish-blue, violet-blue.

CRYSTALS have twelve slightly rectangular faces, but are rare.

Usually found as grains, or granular to compact rock-like masses without visible crystal faces.

OCCURS principally in crystalline limestone; small particles of pyrite are almost always present. Lazurite is not a common mineral.

Lepidolite A source of lithium which, when alloyed with aluminum, is used as a high-heat-resistant metal in supersonic aircraft. Also used in pharmaceutical products and glass making.

COLOR: gray, white, pink, lavender, violet.

CRYSTALS are usually short, six-sided, resembling irregular plates. Found in masses of coarse to fine scales or plates.

OCCURS generally in pegmatites with tourmaline, beryl, spodumene, cassiterite, and columbite.

Limonite A minor ore of iron; also used as a color pigment (yellow ocher). May become magnetic after being heated.

COLOR: black, dark brown, brownish-yellow, yellow.

CRYSTALS: not crystallized. Found in earthy masses having no particular form, in large deposits showing stalactitic shapes, and in rounded lumps resembling grape clusters.

OCCURS as a result of the weathering, or alteration, of other iron minerals. Found with hematite, pyrolusite, siderite, calcite, pyrite, and occasionally with quartz. Much of the yellow color of clay and soil is limonite.

Magnesite A source of magnesium which, combined with oxygen, forms a high-heat-resistant ceramic material used in missiles and jet aircraft. Also used in the manufacture of magnesium flares and refractory bricks.

COLOR: brown, white, gray, yellow.

CRYSTALS are usually so tiny that they cannot be seen even under a microscope, but give a crystalline effect to coarse grained masses. Found principally in noncrystalline, compact rock-like masses, and occasionally in earthy masses.

OCCURS as small to large noncrystalline veins in serpentine, sometimes with chromite. The crystalline variety is usually found in limestone and dolomite.

Magnetite An important and abundant ore of iron; strongly magnetic; may act as a natural magnet (lodestone).

COLOR: iron-black.

CRYSTALS usually have eight faces, occasionally twelve, similar to figures 30 and 28; sometimes deeply grooved. Generally found in coarse to fine grained rock-like masses without visible crystal faces.

OCCURS in diorite, peridotite, gabbro, and schist, with bornite, hematite, ilmenite, garnet, epidote, and occasionally with pyrrhotite, chalcopyrite, and scheelite. Also occurs in the black river and beach sands usually mixed with ilmenite, zircon, and garnet grains. Magnetite is scattered through most igneous rocks, and frequently appears with corundum where it forms emery.

Malachite An ore of copper. Fine malachite is also used as an ornamental stone.

COLOR: bright green.

CRYSTALS are usually slender and needle-like, rarely distinct.

Generally found as groups of indistinct crystals or fibers radiating like the spokes of a wheel; as stalactites; or in rounded lumps resembling grapes. Malachite often shows rows or bands of different shades of green.

OCCURS principally in the upper portions of copper veins lying in limestone, with azurite, cuprite, chrysocolla, and native copper; occasionally with calcite, cinnabar, and uranium and vanadium ores. Also occurs as small rounded lumps coating other minerals.

Marcasite A minor source of sulphuric acid; also used for ornamental purposes, as in costume jewelry, etc.

COLOR: whitish, pale brassy yellow.

CRYSTALS are rather flat, and usually found in groups forming spear-shapes or cockscombs; also found as stalactites, sometimes covered with tiny crystal groups, or in rock-like kidney-shaped masses without visible crystal faces.

OCCURS in limestones, some shales, and clays; in quartz veins; and with pyrrhotite, stibnite, gold, galena, pyrite, smithsonite, and sphalerite.

Microcline An important rock-forming mineral, used in the manufacture of porcelain. May fluoresce in ultraviolet light.

COLOR: green, white, ivory, pale yellow, red.

CRYSTALS have four parallel sides with beveled end faces, somewhat rectangular and block-like, similar to figure 11. Also found as grains, and rock-like masses without visible crystal faces.

OCCURS in granite, syenite, some sandstone, and gneiss; and as small to large crystals in pegmatites; also occurs with orthoclase, quartz and muscovite.

GRAPHIC GRANITE is angular pieces of microcline grown into quartz, and is found in pegmatites.

AMAZON STONE is green microcline that is sometimes used as a gem stone.

Molybdenite Chief ore of molybdenum, used as an alloy in iron and steel. May fluoresce in ultraviolet light.

COLOR: blue-black, lead-gray with bluish tone.

CRYSTALS are six-sided, rarely distinct. Ordinarily found as scales, flakes, or masses of plates or leaves.

OCCURS as veins and deposits in quartz and granite rock areas; also in deposits with scheelite, wolframite, cassiterite, fluorite, pyrite, pyrrhotite, garnet, epidote, and gold ores. Molybdenite is distinguished from graphite by the bluish tint.

Monazite A source of thorium, a high-heat-resistant metal used in supersonic aircraft. Radioactive.

COLOR: brown, yellowish-brown, reddish-brown, red.

CRYSTALS are usually small rather flat squares; rare. Commonly found as grains or granular masses.

OCCURS as grains, sometimes transparent, in granite, gneiss, and dark colored river and beach sands, with quartz, zircon, magnetite, ilmenite, and rutile; and as small crystals and grains in pegmatites with albite, allanite, and garnet. May also occur in placer deposits with gold.

Muscovite Mica, a common rock-forming mineral, used principally as an insulating material.

COLOR: pale brown, pale yellow, pale green, gray, light red, colorless.

CRYSTALS are like plates, either diamond-shaped or roughly six-sided. Ordinarily found as plates, scales, or sheets; as groups of scales in feather-like form; or in compact rock-like masses.

OCCURS in schists, in some of which muscovite is the principal mineral, gneisses, pegmatites, granites, and syenites; with quartz, tourmaline, fluorite, beryl, garnet, andalusite, topaz and apatite. Huge sheets of muscovite are sometimes found, and if transparent, they are of commercial value.

Natrolite A minor rock-forming mineral basically composed of sodium, aluminum, and silicon.

COLOR: colorless, white, gray, light yellow, light red.

CRYSTALS are four-sided, vertically grooved, with low pyramid tops, similar to figure 10. Generally found in groups of crystals or hair-like fibers radiating from a central base, or in pencil-like columns. Also found in granular to compact, or fibrous, rock-like masses without visible crystal faces.

OCCURS as small veins or cavity linings in lava, particularly basalt, with analcite and stilbite. Also as small veins in serpentine in which crystals of benitoite may be embedded.

Olivine (Chrysolite) A common rock-forming mineral having a basic composition of magnesium, iron, and silicon. Transparent crystals are sometimes used as gem stones.

COLOR: brown, green, yellowish-green, grayish-green.

CRYSTALS are usually small with flattened sides. Generally found in small grains, or in granular to compact rock-like masses without visible crystal faces.

OCCURS principally in peridotite, andesite, basalt, and gabbro, with corundum, chromite, magnetite, ilmenite, and hornblende; also in river and stream sands.

DUNITE is a rock composed almost entirely of olivine in which platinum is sometimes found.

PERIDOT is a transparent greenish variety of olivine that is used for gem stones.

Opal Used principally as a gem stone. May fluoresce in ultraviolet light.

COLOR: black, brown, colorless, white, yellow, red, green, gray, blue.

CRYSTALS: none. Found in small to large rounded lumps resembling bunches of grapes; in stalactites; and as crusts, coatings, or earthy masses.

OCCURS in igneous and sedimentary rocks as linings and cavity fillings; around hot springs and geysers; in some petrified woods; occasionally as pebbles in gravel.

PRECIOUS OPAL is white, bluish-white, black, pale yellow; translucent; shows internal play of colors.

FIRE OPAL is a variety of precious opal, white to whitish-blue, with fire-like internal reflections of orange to red; translucent.

COMMON OPAL is white, yellow, red, bluish, black, dull green; waxy luster; no internal play of colors.

WOOD OPAL is wood that has been petrified with opal.

GEYSERITE is the soft, porous, or fibrous coating found around geysers and hot springs; white, grayish, light brown; occasionally has a pearly luster.

HYALITE is colorless to white; transparent; found as rounded lumps or crusts in cavities of volcanic rocks. Will usually fluoresce green in ultraviolet light.

DIATOMITE, also called *diatomaceous earth*, is a fine grained chalk-like variety of opal that is used principally as a polishing material and an abrasive; occasionally found in large deposits.

Orthoclase An important rock-forming mineral basically composed of potassium, aluminum, and silicon, and used principally in the manufacture of porcelain. Some varieties are used as gem stones.

COLOR: colorless, white, gray, flesh-pink, red, pale yellow.

CRYSTALS have four parallel sides with beveled end faces, rectangular and block-like, similar to figure 11; also found as grains, and as coarse to fine granular rock-like masses without visible crystal faces.

OCCURS as small crystals and grains in granites, syenites, rhyolites, and pegmatites, and with albite, quartz, and muscovite. The color of granite is sometimes determined by the color of the orthoclase contained therein.

ADULARIA is colorless, glassy; transparent to translucent; found as small to large crystals, similar to figure 12, in crystalline schists and rhyolites.

MOONSTONE is a variety of adularia having a bluish opalescence. Some moonstone is albite.

SANIDINE is clear and glassy; found as large crystals in igneous rocks, particularly rhyolite.

Pentlandite The most important ore of nickel; occasionally contains varying amounts of cobalt. Nonmagnetic.

COLOR: light bronze-brown, bronze-yellow.

CRYSTALS are even-sided cubes, sometimes with rounded corners; usually found in granular rock-like masses without visible crystal faces.

OCCURS in such igneous rocks as gabbros, in which there is an absence of quartz, and is almost always found with pyrrhotite, and occasionally with chalcopyrite and ores of uranium and vanadium. Unlike pyrrhotite, which it resembles, pentlandite is not magnetic.

Platinum Used in making jewelry, and equipment for chemical laboratories. May be slightly magnetic.

COLOR: light steel-gray, grayish-white.

CRYSTALS are small squares, but are extremely rare. Found principally in rounded grains, scales, pebbles, and nuggets.

OCCURS with olivine, chromite, and magnetite in dunites, peridotites, and some serpentines; also in the dark colored gold-bearing river and beach sands resulting from the disintegration of such rocks. Platinum is obtained from placer deposits by "panning."

Prehnite A possible ornamental or gem stone having a basic composition of calcium, aluminum, and silicon.

COLOR: light brown, white, gray, yellowish-green, light green.

CRYSTALS are very tiny and usually not well formed, giving a crystalline surface to kidney-shaped masses, small lumps resembling grapes, and stalactites. Frequently the tiny crystals are arranged in lines radiating like the spokes of a wheel.

OCCURS in fine grained gabbro, in cavities in basalt, and in serpentine, with calcite, diopside, epidote, and axinite.

Psilomelane An ore of manganese, used in the manufacture of steel. May contain varying amounts of nickel, cobalt and copper.

COLOR: iron-black.

CRYSTALS have no regular form and are shapeless. Found in smooth lumps resembling grapes, in kidney-shaped masses, as stalactites, and in small to large rock-like masses having no particular shape.

OCCURS generally with pyrolusite in limestone and clay; in quartz veins, and occasionally with silver ores; also with rhodonite, rhodochrosite, and jasper.

ABSOLITE is the soft, light weight psilomelane that contains cobalt, and is usually found as masses in clay.

Pyrite A source of sulphuric acid; possibly containing cobalt, nickel, gold, or copper.

COLOR: pale brass yellow.

CRYSTALS are common, usually having six equal grooved faces, similar to figure 31; or like two pyramids placed base-to-base and having eight triangular faces, similar to figure 30; or slightly round and having twelve unequal, occasionally grooved faces, similar to figure 32. Also found in granular to compact rock-like masses without visible crystal faces. Seldom occurs in grains.

OCCURS widespread in all kinds of rocks, particularly in schists, sandstones, slates, and quartzites, and in quartz veins. Found with pyrrhotite, sphalerite, chalcopyrite, galena, and occasionally with ores of uranium and vanadium. Pyrite frequently is closely associated with gold and copper, and may be mined for those metals. Pyrite, like chalcopyrite, is called "fool's gold" because of its color. However, pyrite is harder than chalcopyrite, and more brittle than gold.

Pyrolusite Chief ore of manganese, used in the manufacture of steel, glass, and pottery.

COLOR: iron-black, bluish-steel-gray.

CRYSTALS are six-faced cubes, rather flat; seldom well developed. Usually found in pencil-like columns or fibers radiating from a central base, in kidney-shaped masses, or as a soft earthy mass with the appearance of fern leaves

and small branches. Also found in shapeless granular masses.

OCCURS generally in limestone with psilomelane, and with gold-quartz, limonite, cinnabar, rhodonite, and rhodochrosite. Frequently found in fern-like coatings on pebbles or fracture surfaces, and in small amounts in almost all kinds of rocks.

Pyrrhotite Frequently associated with nickel in sufficient quantity to be mined for that metal; occasionally contains cobalt. Magnetic.

COLOR: brownish-bronze.

CRYSTALS are six-sided, usually flattened, occasionally pyramidal; rare. Ordinarily found in granular or compact rock-like masses without visible crystal faces, or in masses of plates in rock-like form.

OCCURS commonly in small amounts in almost all igneous rocks, or in large masses associated with pentlandite, chalcopyrite, and pyrite; also with tetrahedrite, galena, and sphalerite. Frequently occurs in gold deposits and in veins of quartz; also in layered masses between sandstone and serpentine, in contact deposits with scheelite, and with albite. Nickel-bearing pyrrhotite is sometimes found with ores of uranium and vanadium.

Quartz Crystalline variety, frequently contains gold. Used as ornamental and gem stones, abrasives, and in the manufacture of glass.

COLOR: black, brown, yellow, grayish-yellow, colorless, purple, violet, rose-red, milky-white.

CRYSTALS are six-sided with pyramid tops, similar to figure 26. Occasionally the bottom of the crystal will also show a pyramid, but usually it has a rough, broken look. Horizontal lines or grooves almost always mark the sides of a crystal, and even when crystals are poorly formed this characteristic will be noticeable. Some crystals are very large, while others are very small and may coat the sides of a larger crystal or the inside of a hollow rock, forming

a geode. Also found as granular to compact rock-like masses without visible crystal faces.

OCCURS as crystals, grains, veins, seams, or ledges in granite, pegmatite, rhyolite, basalt, schist, gneiss, quartzite, sandstone and serpentine; also as pebbles or boulders in river and stream beds, and as sea sand. Black quartz is rather rare and found mostly in igneous rocks; gold is generally found in the vicinity of white quartz.

SMOKY QUARTZ or **CAIRNGORM** is frequently in fine transparent crystals of smoky-yellow, grayish-yellow, smoky-brown, and near-black. The dark color may have been caused by association with radioactive minerals. This is a common variety of quartz.

CITRINE or **FALSE TOPAZ** is light yellow to very light brown, and occurs principally in crystals. It is used as a gem stone. **ROCK CRYSTAL** is colorless and transparent. Generally found as distinct crystals, or as pebbles and boulders in stream and river beds. It is used in the optical industry if flawless.

AMETHYST is purple or violet quartz often found in groups of crystals in geodes, and is used principally as a gem stone. May fluoresce in ultraviolet light.

ROSE QUARTZ is pink to rose-red, and is used principally as an ornamental stone. It is generally found in rock-like masses, and occasionally in crystals. The color may fade to a very light pink after long exposure to the weather.

MILKY QUARTZ is the common milky white, translucent to opaque variety that is found as grains and gold-bearing veins in most volcanic, metamorphic, and sedimentary rocks. It frequently has a greasy luster. If two crystals of milky quartz are rubbed together in a darkened room, they will glow momentarily.

There are also other varieties of quartz, some transparent and containing long needle-like threads of rutile, having the appearance of inner scratches, known as *rutilated quartz*, or *sagenite*. Another variety is the rock-like brown, yellow or red quartz containing bright scales of mica or hematite, called *aventurine*.

Rhodochrosite A minor ore of manganese, used in the manufacture of steel; also a possible ornamental stone.

COLOR: brown, rose-red, flesh-pink, gray.

CRYSTALS usually have six slightly curved faces, similar to figure 24, or are in more or less triangular form. Generally found in granular to compact rock-like masses without visible crystal faces, or in small mounds resembling grapes.

OCCURS in veins in quartzite and quartz, and in veins with silver, lead, and copper ores. Found with rhodonite, specular hematite, psilomelane, pyrolusite, garnet, and calcite.

Rhodonite A minor ore of manganese, used in the manufacture of steel. Transparent to sub-transparent variety of good color is frequently used as a gem or ornamental stone.

COLOR: brown, rose-red, pink; often with dark spots.

CRYSTALS are rather flat rectangles with rounded edges, often rough. Ordinarily found in grains, or in granular to compact rock-like masses without visible crystal faces.

OCCURS in deposits in schists, gneisses, and crystalline limestones, and with rhodochrosite, pyrolusite, psilomelane, garnet, epidote, and quartz. Also found as rocks and pebbles in river, stream, and beach sands.

Rutile A source of titanium, which is used as an alloy in high-heat-resistant steel for supersonic aircraft, and as a paint pigment. Crystals of deep red or black have been cut into brilliant gems.

COLOR: black, brownish-black, deep red, reddish-yellow, brown, reddish-brown.

CRYSTALS are four sided with vertical grooves; frequently two crystals will be grown together in an elbow shape, similar to figure 58. Also common in long needle-like crystals, and in twin crystals of hollow network or lattice design. Also in grains, and compact rock-like masses without visible crystal faces.

OCCURS in granite, pegmatite, quartzite, gneiss, mica schist, serpentine, crystalline limestone, and dolomite, with anda-

lusite, sphene, ilmenite, chlorite, garnet, dumortierite, and quartz. Also occurs in dark colored river and beach sands with zircon, magnetite, and monazite.

SAGENITE is clear quartz with embedded hair-like or needle-like rutile.

Scheelite A major source of tungsten, used in hardening steel; frequently contains varying amounts of molybdenum. Highly fluorescent in ultraviolet light.

COLOR: brown, green, yellow, gray, white.

CRYSTALS are like two pyramids placed base-to-base, usually imperfect. Generally found in rock-like masses without visible crystal faces.

OCCURS in deposits in contact zones of granite and crystalline limestone, and in pegmatites. Also occurs in veins with cassiterite, wolframite, and molybdenite; in quartz veins, sometimes with gold; and in crystalline limestones with garnet, diopside and idocrase. Because of its high fluorescent quality, scheelite is usually sought at night with the aid of an ultraviolet light.

Serpentine May contain varying amounts of nickel and iron.

The fibrous variety, *chrysotile*, is a major source of asbestos; the dark green to yellowish-green variety, usually with a mottled appearance, is called *serpentine marble*, and is used as a building stone; *antigorite* is a platy, translucent variety used to some extent as an ornamental stone.

The rock serpentine is mostly antigorite.

COLOR: near-black, blackish-green, yellowish-green, yellowish-brown, brownish-green, pale brown, reddish, near-white.

CRYSTALS are not known. Generally found in fibrous to compact rock-like masses.

OCCURS in alternating bands of serpentine and asbestos (*chrysotile*), or in large shapeless masses (*antigorite*). Found particularly in peridotites, basalts, gabbros, and some schists, associated with magnesite, magnetite, and chromite. As an alteration product of olivine, serpentine is also associated with corundum and platinum.

Siderite An ore of iron. Will become magnetic after being heated in a candle flame.

COLOR: light to dark brown, gray.

CRYSTALS have six frequently curved faces meeting at oblique angles, similar to figure 24. Usually found in granular to compact rock-like masses without visible crystal faces, or earthy masses.

OCCURS as rock-like and crystal masses in limestone, schist, quartz veins; occasionally in sandstone and serpentine; and with galena, pyrite, tetrahedrite, albite, pyrrhotite, hematite, limonite, and silver ores.

Sillimanite (Fibrolite) A possible gem stone having a basic composition of aluminum and silicon.

COLOR: bluish-green, green, white, brown, gray.

CRYSTALS are usually long and slender with indistinct end faces. Often found in groups of crystals or fibers in pencil-like columns.

OCCURS in gneisses and schists with staurolite, kyanite, dumortierite, andalusite, quartz, and muscovite; frequently found with corundum, and occasionally as pebbles in stream beds.

Silver Frequently contains varying amounts of gold and copper, occasionally platinum.

COLOR: silver-gray, silver-white.

CRYSTALS are usually malformed and distorted, but incline toward being slightly round with many triangular faces; individuals are not distinct, appearing instead as groups in branch-like, wire-like, or moss-like formations. Also found in scales, plates, and flakes.

OCCURS as small veins in granite and quartz, and with ores of gold, cobalt, zinc, nickel, and occasionally uranium and vanadium. Also found with bornite, chalcocite, chalcopyrite, tetrahedrite, and galena. These minerals sometimes contain sufficient silver to be mined for that metal. Argentite and sylvanite are the major ores of silver.

Smithsonite An ore of zinc, and a possible ornamental stone.

COLOR: blue, green, grayish, brownish, red to pink, yellow, white.

CRYSTALS are small and rare, usually appearing as a crystalline coating or layer. Found principally in kidney-shaped masses or rounded lumps resembling bunches of grapes, also granular, earthy, stalactitic, or in honeycombed masses.

OCCURS generally in limestone, occasionally in dolomite, with galena, sphalerite, cerussite, anglesite, calcite, and limonite. Smithsonite is formed by the alteration of sphalerite.

DRY-BONE ORE appears in crystalline coatings or honeycombed masses resembling dried bone.

TURKEY FAT ORE is a yellow variety of smithsonite containing cadmium, which is used as an oxidation-resistant plating for supersonic aircraft parts, and in the manufacture of glass, porcelain, and paint.

Sphalerite The most important ore of zinc; may fluoresce in ultraviolet light. Sphalerite sometimes contains sufficient cadmium to be a major source of that metal. Cadmium is used as an oxidation-resistant plating for supersonic aircraft parts, and in the manufacture of glass, porcelain and paint.

COLOR: black, yellow, yellow-brown, brown, red, white, green.

CRYSTALS have four triangular faces with flattened corners, similar to figure 38, but are usually so poorly formed they appear almost round. Generally found as coarse to fine granular rock-like masses without visible crystal faces.

OCCURS principally in veins and deposits in limestone, and in igneous rocks. Associated with, and could be mistaken for, galena. Also occurs frequently with pyrite, tetrahedrite, chalcopyrite, arsenopyrite; and also with fluorite, pyrrotite, marcasite, smithsonite, calcite, and dolomite. It is occasionally found with ores of uranium and vanadium. Fine grained sphalerite sometimes contains varying

amounts of barite, chalcopyrite, or kaolinite and barite, and will glow momentarily when rubbed.

Sphene (Titanite) A potential ore of titanium, which is used as an alloy in high-heat-resistant steel for supersonic aircraft, and as a paint pigment. Sphene is used to some extent as a gem, but its softness hinders widespread usage.

COLOR: black, green, yellow, greenish-yellow, brown, gray.
CRYSTALS are well developed, wedge shaped, usually thin with sharp edges, similar to figure 13. Found in crystals and grains, occasionally in granular rock-like masses without visible crystal faces.

OCCURS commonly as tiny crystals or grains in granites, diorites, and syenites, and as larger crystals in schists, gneisses, pegmatites, and crystalline limestones. Occurs frequently with iron ores, and with chlorite, hornblende, orthoclase, zircon, quartz, garnet, and epidote; occasionally with andalusite, apatite, black tourmaline and dumortierite.

Spinel Used principally as gem stones.

COLOR: black, blue, green, brown, red, violet, yellow, white.
CRYSTALS usually have eight triangular faces and resemble two pyramids placed base-to-base, or intergrown into twin crystals, similar to figures 30 and 34. Also found as irregular grains and rounded pebbles.

OCCURS in crystalline limestones, gneisses, serpentines, peridotites, dunites, and basalts, and with graphite, pyrrhotite, chromite, and garnet. Also occurs as rounded pebbles or grains in river, stream, and beach sands, possibly with gem quality corundum.

PLEONASTE is the dark green to black spinel, sometimes transparent. It is found principally in basalts.

SPINEL SAPPHIRE is a light to deep blue or white variety of spinel which, when transparent, cuts into beautiful gem stones.

PICOTITE is the yellowish-brown, greenish-brown, or dark brown spinel found in serpentines and basalts.

RUBY SPINEL is rose-red to clear deep red, and usually found in river or beach sands.

Spodumene A major source of lithium which, when alloyed with aluminum, is used as a high-heat-resistant metal in supersonic aircraft; also used in pharmaceutical products. The pink, lavender, and green varieties are frequently used as gem stones. May fluoresce in ultraviolet light.

COLOR: gray, white, emerald green, lavender, pink, yellow.
CRYSTALS are long, flattened, vertically grooved rectangles having slight pyramid tops and uneven bottoms; frequently very large. Also in grains, or coarse compact masses. A crystal may show different colors when held to a light and turned.

OCCURS principally in pegmatites with beryl, garnet, topaz, quartz, lepidolite, and tourmaline. Spodumene is not a common mineral, and will alter to albite, muscovite, or microcline.

HIDDENITE is emerald green spodumene, and is used as a gem stone.

KUNZITE is lavender to pink, transparent, and is considered to be an excellent gem stone.

Staurolite Used as an ornamental gem stone. A small piece of staurolite will appear blood-red or orange when held to a light.

COLOR: brownish-black, yellowish-brown, reddish-brown, dark brown.

CRYSTALS are rectangular in shape, with front faces meeting at a steep angle; usually found as two crystals grown together at right angles forming a cross, similar to figure 51, or like the letter X. Also found as grains, rarely as rock-like masses.

OCCURS as crystals and grains in crystalline schists, slates, and gneisses with garnet, tourmaline, kyanite, quartz, and hornblende.

Stephanite An important ore of silver.

COLOR: iron-black.

CRYSTALS are generally short and box-like, intergrown in such a way that they appear almost six-sided with flattened tops;

occasionally the crystal faces will be vertically grooved. Frequently found as grains or in compact rock-like masses without visible crystal faces.

OCCURS in veins with native silver, argentite, tetrahedrite, galena and sphalerite, and with quartz, calcite and fluorite.

Stibnite Chief ore of antimony, a metal used in the manufacture of type metal, bearings, etc. May contain varying amounts of gold, silver, iron, copper, and lead.

COLOR: black with slight bluish tint, lead-gray.

CRYSTALS are long and slender, often bent or curved, with deep grooves along the length, and spear shaped tops. Frequently in groups of crystals resembling knife blades, or hair-like and radiating like the spokes of a wheel. Also in coarse to fine granular rock-like masses without visible crystal faces.

OCCURS as small to large veins in granites, gneisses, schists, limestones, and shales; also in quartz veins, and with gold, silver, cobalt, and nickel ores. Frequently found with cinnabar, galena, chalcopyrite, and tetrahedrite.

Stilbite A rock-forming mineral basically composed of aluminum, calcium, and sodium.

COLOR: brown, yellow, yellowish-brown, white, red.

CRYSTALS are long and slender, slightly flat, plate-like. Usually in groups of crystals narrow in the center and fanning out at the ends, similar to figure 14.

OCCURS in cavities, seams, and on fracture surfaces in diorite and basalt; and with biotite, hornblende, calcite, apatite, and natrolite.

Sulphur Used in the manufacture of sulphuric acid, gunpowder, insecticides, medicines, etc.

COLOR: yellow, brownish-yellow, greenish-yellow, grayish-yellow, reddish-yellow.

CRYSTALS are in the form of two pyramids placed base-to-base, similar to figure 52, sometimes with flattened tops

and bottoms. Found in shapeless masses of imperfect crystals, or in masses without visible crystal faces; also in crusts, stalactites, and powdery or earthy forms. The warmth of the hand will cause sulphur crystals to expand and crackle, and when rubbed they may generate sufficient electricity to pick up tiny bits of paper. They are more or less fragile, and should be handled carefully.

OCCURS near geysers, hot springs, and volcanoes; in limestone, usually with gypsum; often in clay; and occasionally in sandstone and decomposed serpentine. Found with celestite, calcite, anhydrite, fluorite, and sometimes with cinnabar and andalusite.

Sylvanite An ore of gold, silver, and tellurium, an element used as a corrosion resistant in lead and to increase the strength of rubber.

COLOR: steel-gray, brassy-yellow, silver-white.

CRYSTALS are slender and flattened, resembling knife blades; seldom distinct. Often in groups of imperfect crystals implanted on rocks and resembling writing, or in granular masses without visible crystal faces.

OCCURS in or near granite, and in limestone, with gold, marcasite, pyrite, and calaverite, and with quartz, opal, chalcedony, and fluorite.

Talc A basic composition of magnesium and silicon, possibly containing varying amounts of nickel. Used in the manufacture of paints, ceramics, etc.

COLOR: light to dark gray, white, green.

CRYSTALS are rare. Generally found in masses of thin six-sided plates, or in granular to compact rock-like masses.

OCCURS in schists, peridotites, and some limestones, and with actinolite, serpentine, and kyanite.

SOAPSTONE is a variety of talc found mostly in metamorphic rocks, and with chlorite and serpentine. An entire rock may be made up of soapstone.

Tetrahedrite An ore of copper. Some varieties contain sufficient silver to be a valuable source of that metal.

COLOR: iron-black, grayish-black, dark gray.

CRYSTALS are distinct and kite-shaped, similar to figure 39, possibly in groups resembling parallel columns. Also found as coarse to fine granular rock-like masses without visible crystal faces.

OCCURS in most igneous rocks, and in schists, limestones, and quartz, generally with galena, pyrite, sphalerite, chalcocopyrite, pyrrotite, stibnite, cerussite, gold, silver, and argentite.

Thorite A source of thorium, a high-heat-resistant metal used in supersonic aircraft engines. Radioactive.

COLOR: black, grayish, brownish, brownish-yellow, orange-yellow, reddish, green.

CRYSTALS are usually four-sided and rectangular, with slight pyramid tops and bottoms, similar to figures 59 and 60.

Also found in rock-like masses without visible crystal faces.

OCCURS in granites, syenites, contact zones, and river sands, and in pegmatites with allanite and zircon.

ORANGEITE is the orange-yellow or brownish-yellow alteration product of thorite.

Topaz A gem stone. May fluoresce in ultraviolet light.

COLOR: bluish, greenish, white, colorless, pink, yellow.

CRYSTALS are eight-sided, frequently vertically grooved, with tops shaping to a point, or with the point flattened, similar to figure 53. Found as small to large crystals, and as coarse to fine granular crystalline masses. If a topaz crystal is rubbed, it will generate enough electricity to pick up bits of paper.

OCCURS in cavities in rhyolites and granites, and in pegmatites; also as tiny crystals, grains, or rolled pebbles in stream beds. Occurs with tourmaline, cassiterite, beryl, quartz, apatite, fluorite, andalusite, mica, and orthoclase.

Torbernite An ore of uranium, containing varying amounts of copper. Radioactive; may fluoresce in ultraviolet light.

COLOR: emerald-green, grass-green, apple-green, yellow-green.

CRYSTALS are nearly square plates, thick or thin; also in soft plate-like structures, like mica.

OCCURS in pegmatites, some light colored sandstones, particularly those having streaks or layers of a darker color, some limestones and black shales, and in the upper portions of copper deposits. Because of its color, torbernite could be mistaken for some of the green copper ores. Torbernite alters from pitchblende, and may be a surface guide to that mineral.

Tourmaline A semi-precious gem stone; also used in the manufacture of gauges, radio parts, etc. Some varieties are a source of lithium which, when alloyed with aluminum, is used as a heat-resistant metal in supersonic aircraft. May fluoresce in ultraviolet light.

COLOR: black, brown, yellow, pink, red, blue, green, white, colorless.

CRYSTALS are generally long and slightly triangular, appearing almost round, showing three triangular faces on the top and vertical grooves along the sides, similar to figure 27. Found in individual crystals, or groups of crystals radiating like the spokes of a wheel; in columnar formation; and in fine grained granular masses. A tourmaline crystal will show different colors when held to a light and turned.

OCCURS in granites, pegmatites, crystalline limestones, sandstones, schists, gneisses, and in quartz veins. Black is the most common, and occurs in granites, pegmatites, schists, gneisses, and quartz veins; red and green are found primarily in quartz, and brown tourmaline is found in crystalline limestone. Transparent gem quality tourmaline is generally found in pegmatites, and the translucent pale red and green lithia tourmaline is found exclusively in pegmatites.

Tremolite A rock-forming mineral basically composed of calcium, magnesium, and silicon, occasionally containing

varying amounts of gold. The fibrous, silky variety is used as a type of asbestos.

COLOR: gray, white.

CRYSTALS are generally long and slender, similar to figure 1, resembling knife blades; or short and stout. Usually found as groups of bladed crystals in pencil-like columns radiating like the spokes of a wheel; also in fine to coarse granular or compact rock-like masses without visible crystal faces.

OCCURS principally in crystalline limestones, schists, gneisses, and granites, and with actinolite, diopside, and calcite.

Turquoise Used as a gem or ornamental stone.

COLOR: blue, bluish-green, green, apple-green.

CRYSTALS are extremely small and rare, usually so tiny that they cannot be seen under a microscope. Found in rounded kidney-shaped lumps, stalactites, compact rock-like masses, and as crusts or grains.

OCCURS usually in small veins or pockets in areas of decomposed volcanic rocks, and occasionally in schists.

Uraninite—Pitchblende One of the most important sources of uranium, containing varying amounts of radium and lead. Highly radioactive; will not fluoresce.

COLOR: velvety-black, greenish-black, grayish-black, brownish-black.

CRYSTALS are cube shaped, rare. Found principally in large rounded lumps resembling grapes, or in rock-like masses.

OCCURS in and around granite rocks; in some light colored sandstones, usually those having streaks or layers of a darker color; pegmatites; and in some limestones and black shales. Also occurs in varying amounts in veins of silver, lead, copper, and gold ores. The green torbernite and the highly fluorescent autunite are alteration products of pitchblende, and may be surface guides to that mineral. Both guide minerals could be mistaken for one of the green copper ores.

Vanadinite An ore of vanadium and lead, used in the process of hardening steel.

COLOR: brown, yellowish-brown, reddish-brown, ruby-red, straw-yellow.

CRYSTALS are six-sided with pyramid tops, and occasionally pyramid bases. The crystals will sometimes be flattened and semi-round, and appear in groups around a hollow center.

OCCURS principally in the upper portions of lead deposits with cerusite and galena, and occasionally as tiny ruby red crystals on calcite.

Willemite A major ore of zinc. Strongly fluorescent in ultra-violet light.

COLOR: blue, green, white, red, brown.

CRYSTALS are six-sided, short, with sharp oblique angles at the ends; rare. Generally found in granular to compact rock-like masses without visible crystal faces.

OCCURS principally in crystalline limestone, usually with hemimorphite or smithsonite.

Wolframite A major source of tungsten, used as an alloy to harden steel.

COLOR: black, dark brown, red.

CRYSTALS show six vertical faces with the side faces meeting at a sharp angle, vertically grooved, similar to figure 15.

Also found in granular to compact rock-like masses without visible crystal faces.

OCCURS in granites, pegmatites, quartz veins, and occasionally in schists. Commonly found with scheelite, pyrite, and galena, and with cassiterite, cinnabar, and chalcopyrite.

Wollastonite A basic composition of calcium and silicon used in ceramics and in making rock wool for insulation.

May fluoresce in ultraviolet light.

COLOR: brown, white, gray, rose-red, yellow.

CRYSTALS are rather flat, with rectangular faces meeting at

oblique angles. Usually found as fibers radiating like the spokes of a wheel, in pencil-like columns, or in compact rock-like masses without visible crystal faces.

OCCURS primarily in crystalline limestones with diopside, scheelite, calcite, epidote, idocrase, and garnet. Occasionally found in schists with quartz.

Zircon A source of zirconium, used as a temperature control factor in rockets, and to some extent in the manufacture of refractory bricks. Transparent zircons are excellent gem stones.

COLOR: brown, grayish, yellowish, greenish, reddish, colorless, pink.

CRYSTALS are four-sided with pyramid ends; usually short and stout, similar to figure 59; or long and slender, similar to figure 60; also in irregular grains.

OCCURS commonly as tiny crystals or grains in granites, syenites, and in some rhyolites, and as larger crystals in pegmatites, crystalline limestones, schists, and gneisses. Also occurs as rounded grains or small pebbles in river, stream, and beach sands, frequently with gold. Platinum is sometimes found with zircon in black sands.

Zoisite A possible gem stone, basically composed of calcium, aluminum, and silicon. May fluoresce in ultraviolet light.

COLOR: brown, pink, rose-red, greenish, gray, grayish-white.

CRYSTALS are usually long, somewhat rectangular, with pointed tops; occasionally found in groups of needle-like crystals radiating like the spokes of a wheel, or in pencil-like columns. Also found in compact rock-like masses without visible crystal faces.

OCCURS in gabbros, schists, pegmatites, quartz veins, and contact zones, with albite, scheelite, axinite, rhodonite, and actinolite.

THULITE is a pink variety of zoisite generally found in pegmatites and contact zones.

7 - Chemical Composition of Minerals

THE majority of minerals are composed of various chemical elements which are expressed by the use of abbreviations, or symbols, of the Latin or English names: Ag is the abbreviation of the Latin word "argentum," meaning silver; Ba from the English word "barium," etc. By using the table of symbols listed below, plus H₂O for water, and (OH) for hydroxyl, the chemical formula of a mineral is not difficult to read. For example, the formula of argentite is Ag₂S, which means that this mineral is composed of two atoms of silver and one atom of sulphur; FeAsS (arsenopyrite) is one atom each of iron, arsenic and sulphur; C₅FeS₄ (bornite) is five atoms of copper, one of iron, and four of sulphur. When symbols are divided by a comma and appear in parentheses, (Mg,Fe), either element may be present. The small letter *n* preceding a symbol denotes a variable number of atom groups.

Ag Silver	F Fluorine	S Sulphur
Al Aluminum	Fe Iron	Sb Antimony
As Arsenic	H Hydrogen	Si Silicon
Au Gold	Hg Mercury	Sn Tin
B Boron	K Potassium	Sr Strontium
Ba Barium	La Lanthanum	Ta Tantalum
Be Beryllium	Li Lithium	Te Tellurium
C Carbon	Mg Magnesium	Th Thorium
Ca Calcium	Mn Manganese	Ti Titanium
Cb Columbium	Mo Molybdenum	U Uranium
Cd Cadmium	Na Sodium	V Vanadium
Ce Cerium	Ni Nickel	W Tungsten
Cl Chlorine	O Oxygen	Y Yttrium
Co Cobalt	P Phosphorus	Zn Zinc
Cr Chromium	Pb Lead	Zr Zirconium
Cu Copper	Pt Platinum	

CHEMICAL COMPOSITION OF METALS

The following minerals are fully described in this manual:

Actinolite $\text{Ca}_2(\text{Mg},\text{Fe})_5\text{Si}_8\text{O}_{22}(\text{OH})_2$	Chlorite $(\text{Mg},\text{Fe})_3(\text{Al},\text{Fe})_2\text{Si}_5\text{O}_{10}(\text{OH})_3$
Agate SiO_2	Chromite FeCr_2O_4
Albite $\text{NaAlSi}_3\text{O}_8$	Chrysoberyl BeAl_2O_4
Allanite $(\text{Ca},\text{Ce},\text{La},\text{Na})_2(\text{Al},\text{Fe},\text{Mn},\text{Be},\text{Mg})_3(\text{SiO}_4)_5\text{OH}$	Chrysocolla $\text{CuSiO}_2 \cdot 2\text{H}_2\text{O}$
Amblygonite $\text{LiAl}(\text{F},\text{OH})\text{PO}_4$	Cinnabar HgS
Analcite $\text{Na}_4\text{Al}_3\text{Si}_3\text{O}_{10} \cdot \text{H}_2\text{O}$	Cobaltite $(\text{Co},\text{Fe})\text{AsS}$
Andalusite AlSiO_3	Colemanite $\text{Ca}_2\text{B}_6\text{O}_{11} \cdot 5\text{H}_2\text{O}$
Anglesite PbSO_4	Columbite $(\text{Fe},\text{Mn})(\text{Cb},\text{Ta})_2\text{O}_6$
Anhydrite CaSO_4	Copper Cu
Apatite $\text{Ca}_5(\text{F},\text{Cl},\text{OH})(\text{PO}_4)_3$	Cordierite $(\text{Fe},\text{Mg},\text{Mn})_2(\text{Al},\text{Fe})_2\text{Si}_5\text{O}_{18} \cdot \text{H}_2\text{O}$
Aragonite CaCO_3	Corundum Al_2O_3
Argentite Ag_2S	Covellite CuS
Arsenopyrite FeAsS	Cuprite Cu_2O
Augite $\text{Ca}(\text{Mg},\text{Fe},\text{Al})(\text{Al},\text{Si})_2\text{O}_6$	Diamond C
Autunite $\text{CaO} \cdot 2\text{UO}_3 \cdot \text{P}_2\text{O}_5 \cdot 8\text{H}_2\text{O}$	Diopside $\text{CaMg}(\text{SiO}_3)_2$
Axinite $\text{H}(\text{Ca},\text{Mn},\text{Fe})_2\text{Ba}(\text{SiO}_4)_2$	Dolomite $\text{CaMg}(\text{CO}_3)_2$
Azurite $2\text{CuCO}_3 \cdot \text{Cu}(\text{OH})_2$	Dumortierite $\text{Al}_3\text{BSi}_5\text{O}_{18}(\text{OH})$
Barite BaSO_4	Epidote $\text{Ca}_2(\text{Al},\text{Fe})_2(\text{SiO}_4)_2(\text{OH})$
Bauxite $\text{Al}(\text{OH})_3$	Fluorite CaF_2
Benitoite $\text{BaTiSi}_2\text{O}_8$	Galena PbS
Beryl $\text{Be}_3\text{Al}_2\text{Si}_6\text{O}_{18}$	Garnet:
Biotite $\text{K}(\text{Mg},\text{Fe},\text{Al})_2(\text{Si},\text{Al})_4\text{O}_{10}(\text{O},\text{OH})_2$	Almandite $\text{Fe}_3\text{Al}_2\text{Si}_5\text{O}_{18}$
Borax $\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$	Andradite $\text{Ca}_3\text{Fe}_2\text{Si}_3\text{O}_{12}$
Bornite Cu_5FeS_4	Grossularite $\text{Ca}_3\text{Al}_2\text{Si}_2\text{O}_{12}$
Calaverite AuTe_2	Pyrope $\text{Mg}_3\text{Al}_2\text{Si}_5\text{O}_{18}$
Calcite CaCO_3	Spessartite $\text{Mn}_3\text{Al}_2\text{Si}_5\text{O}_{18}$
Carnotite $\text{K}_2(\text{UO}_2)_2(\text{VO}_4)_2 \cdot 3\text{H}_2\text{O}$	Uvarovite $\text{Ca}_3\text{Cr}_3\text{Si}_3\text{O}_{12}$
Cassiterite SnO_2	Garnierite $\text{H}_2(\text{Ni},\text{Mg})\text{SiO}_4 + \text{H}_2\text{O}$
Celestite SrSO_4	Gold Au
Cerussite PbCO_3	Graphite C
Chalcedony SiO_2	Greenockite CdS
Chalcocite Cu_2S	Gypsum $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$
Chalcopyrite CuFeS_2	Halite NaCl
	Hematite Fe_2O_3
	Hemimorphite $\text{Zn}_2\text{Si}_2\text{O}_7(\text{OH})_2 \cdot \text{H}_2\text{O}$

Hornblende $\text{Ca}_2\text{Na}_2(\text{Mg,Fe})_2$ - (Al,Fe,Ti) $_2\text{Si}_7\text{O}_{22}(\text{O},\text{OH})_4$	Quartz SiO_2
Idocrase $\text{Ca}_2\text{Al}_2(\text{Mg,Fe})_2$ - $\text{Si}_5\text{O}_{14}(\text{OH})_4$	Rhodochrosite MnCO_3
Ilmenite FeTiO_3	Rhodonite MnSiO_3
Jadeite $\text{NaAl}(\text{SiO}_3)_2$	Rutile TiO_2
Kaolinite $\text{Al}_2\text{Si}_2\text{O}_7(\text{OH})_2$	Scheelite CaWO_4
Kernite $\text{Na}_2\text{B}_2\text{O}_7 \cdot 4\text{H}_2\text{O}$	Serpentine $\text{H}_2\text{Mg}_3\text{Si}_2\text{O}_{10}$
Kyanite AlSiO_3	Siderite FeCO_3
Lazulite $(\text{Fe,Mg})\text{Al}_2(\text{OH})_2$ - P_2O_5	Sillimanite AlSiO_3
Lazurite $\text{Na}_2\text{-}_{10}\text{Al}_3\text{Si}_6\text{O}_{24} \cdot \text{S}_2$	Silver Ag
Lepidolite $\text{K}(\text{Li,Al})_2(\text{Si,Al})_4$ - $\text{O}_{10}(\text{O,OH,F})_2$	Smithsonite ZnCO_3
Limonite $\text{Fe}_2\text{O}_3 \cdot n\text{H}_2\text{O}$	Sphalerite ZnS
Magnesite MgCO_3	Sphene CaTiSiO_5
Magnetite Fe_3O_4	Spinel $\text{MgO} \cdot \text{Al}_2\text{O}_3$
Malachite $\text{CuCO}_3 \cdot \text{Cu}(\text{OH})_2$	Spodumene $\text{LiAl}(\text{SiO}_3)_2$
Marcasite FeS_2	Staurolite $\text{FeAl}_3\text{Si}_2\text{O}_{10}(\text{OH})_2$
Microcline $\text{KA1Si}_3\text{O}_8$	Stephanite Ag_5Sb_4
Molybdenite MoS_2	Stibnite Sb_2S_3
Monazite $(\text{Ce,Lu,Y,Th})\text{PO}_4$	Stilbite $(\text{Ca,Na,K})_2\text{Al}_{10}(\text{Al,Si})_2$ - $\text{Si}_{10}\text{O}_{30} \cdot 30\text{H}_2\text{O}$
Muscovite $(\text{K,Na})(\text{Al,Mg})$ $(\text{Si,Al})_3\text{O}_{10}(\text{OH})_2$	Sulphur S
Natrolite $\text{Na}_2\text{Al}_2\text{Si}_2\text{O}_{10} \cdot 2\text{H}_2\text{O}$	Sylvanite $(\text{Au,Ag})\text{Te}_2$
Olivine $(\text{Mg,Fe})_2\text{SiO}_4$	Talc $\text{Mg}_3\text{Si}_4\text{O}_{10}(\text{OH})_2$
Opal $\text{SiO}_2 \cdot n\text{H}_2\text{O}$	Tetrahedrite $(\text{Cu,Fe})_{12}\text{Sb}_4\text{S}_{12}$
Orthoclase KAlSi_3O_8	Thorite ThSiO_4
Pentlandite $(\text{Fe,Ni})_9\text{S}_8$	Topaz $\text{Al}_2(\text{F,OH})_2\text{SiO}_4$
Platinum Pt	Tourmaline $\text{WX}_2\text{B}_3\text{Al}_3(\text{AlSi}_2$ - $\text{O}_7)_2(\text{O,OH,F})_4$; $\text{W}=\text{Na},$ Ca and $\text{X}=\text{Al,Fe,Li,Mg}$
Prehnite $\text{H}_2\text{Ca}_2\text{Al}_2\text{Si}_2\text{O}_{12}$	Tremolite $\text{Ca}_2\text{Mg}_5\text{Si}_8\text{O}_{22}(\text{OH})_2$
Psilomelane $\text{BaR}_2\text{O}_{10} \cdot 2\text{H}_2\text{O}(?)$ $\text{R}=\text{Mn}$, chiefly, also $\text{Mn},$ Co	Turquoise $\text{H}_2(\text{CuOH})[\text{Al}(\text{O}-$ $\text{H})_2]_2(\text{PO}_4)_4$
Pyrite FeS_2	Uraninite UO_2 or $\text{U}_3\text{-}_4\text{O}_8$
Pyrolusite MnO_2	Vanadinite $(\text{PbCl})\text{Pb}_4(\text{VO}_4)_3$
Pyrrhotite Fe_{1-2}S	Willemite Zn_2SiO_4
	Wolframite $(\text{Fe,Mn})\text{WO}_4$
	Wollastonite CaSiO_3
	Zircon ZrSiO_4
	Zoisite $\text{Ca}_2\text{Al}_2(\text{SiO}_4)_2(\text{OH})$

Dana's Manual of Mineralogy, 16th Edition, is the formula authority for augite, carnotite, chlorite, columbite, monazite, and tourmaline. All others are from *Minerals of California*, Bulletin 173, California State Division of Mines.

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